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The Names of Contributors are Printed in Small Capitals.

Illustrating Article by Professor G. F. Atkinson on 'Report of Some Preliminary Experiments with the Röntgen Rays on Plants.' *Peltandra undulata*: normal photograph above, Röntgen photograph below.

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FRIDAY, JANUARY 7, 1898.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE PHILOSOPHY OF HYPER-SPACE.**

THERE is a region of mathematical thought which might be called the fairyland of geometry. The geometer here disports himself in a way which, to the non-mathematical thinker, suggests the wild flight of an unbridled imagination rather than the sober sequence of mathematical demonstration. Imaginative he certainly does become, if we apply this term to every conception which lies outside of our human experience. Yet the results of the hypotheses introduced into this imaginary universe are traced out with all the rigor of geometric demonstration. It is quite fitting that one who finds the infinity of space in which our universe is situated too narrow for his use should, in his imaginative power, outdo the ordinary writer of fairy tales, when he evokes a universe sufficiently extended for his purposes.

The introduction of what is now very generally called hyper-space, especially space of more than three dimensions, into mathematics has proved a stumbling block to more than one able philosopher. The question whether a fourth dimension may possibly exist, and whether it can be legitimately employed for any mathematical purpose, is one on which clear ideas are not universal. I do not, however, confine the term 'hyper-space' to space of more than

*Address of the President before the American Mathematical Society, December 29, 1897.

three dimensions. A hypothesis which is simpler in its fundamental basis, and yet seems absurd enough in itself, is that of what is sometimes, improperly I think, called curved space. This also we may call hyper-space, defining the latter in general as space in which the axioms of the Euclidean geometry are not true and complete. Curved space and space of four or more dimensions are completely distinct in their characteristics, and must, therefore, be treated separately.

The hypothesis of a fourth dimension can be introduced in so simple a way that it should give rise to no question or difficulty whatever. Indeed, the whole conception is so simple that I should hardly deem it necessary to explain the matter to a professional mathematical student. But as we all have to come in contact with educated men who have not had the time to completely master mathematical conceptions, and yet are interested in the fundamental philosophy of our subject, I have deemed it appropriate to present the question in what seems to me the simplest light.

The student of geometry begins his study with the theory of figures in a plane. In this field he reaches certain conclusions, among them that only one perpendicular can be drawn to a line at a given point, and that only one triangle can be erected with given sides on a given base in a given order. Having constructed this plane geometry, he passes to geomety of three dimensions. Here he enters a region in which some of the propositions of plane geometry cease to be true. An infinity of perpendiculars can now be drawn to a given line at a given point, and an infinity of triangles can be constructed on a given base with given sides. He has thus considered in succession geometry of two dimensions, and then passed to geometry of three dimensions. Why should he stop there? You reply, perhaps, because there are only three dimensions in actual space. But in making hypotheses we need not limit ourselves to actualities; we can improve our methods of research, and gain clearer conceptions of the actual by passing outside and considering the possible.

For logical purposes there is no limit to the admissibility of hypotheses, provided we consider them purely as hypotheses, and do not teach that they are actual facts of the universe. It is, therefore, perfectly legitimate to inquire what our geometry would be if, instead of being confined to three dimensions, we introduced a fourth. Many curious conclusions follow. When we are confined to a plane a circle completely bounds a region within the plane, so that we cannot pass from the inside to the outside of the circle without intersecting it. Beings conscious only of two dimensions and moving only in two dimensions, and placed inside such a material circle, would find themselves completely imprisoned, with no possibility of getting outside. But give them a third dimension, with the power to move into it, and they simply step over the circle without breaking it. They do not have to even touch it. Living, as we do, in space of three dimensions, the four walls, pavement and ceiling of a dungeon, confine a person so completely that there is no possibility of escaping without making an opening through the bounding surface. But give us a fourth dimension, with the faculty of moving into it, and we pass completely outside of our three dimensional universe, by a single step, and get outside the dungeon as easily as a man steps over a line drawn on the ground. Were motion in the fourth dimension possible, an object moving in that dimension by the smallest amount would be completely outside of what we recognize as the universe, and would, therefore, become invisible. It could then be turned around in such a way that on being brought

back it would be obverted, or appear as in a looking glass. A man capable of such a motion would come back into our sight similarly obverted, his left side would now be his right, without any change having taken place in the relative positions of the particles of his body. The somerset he would have turned would have completely obverted every atom and molecule of his body without introducing any disturbance into its operations.

This possibility of obversion brings in a curious question concerning the rigor of one of the fundamental propositions in elementary geometry. Euclid proves by superposition that the two triangles in a plane having two angles and the included side equal are equal to each other. In the demonstration it is assumed that the triangles can be made congruent by simply placing one upon the other without taking it out of the plane. From this the conclusion is drawn that the same conclusion holds true if one of the triangles be obverted. But in this case they cannot be brought into congruence without taking one of them out of the plane and turning it over. The third dimension is thus assumed in geometry involving only two dimensions.

Now consider the analogous case in space. Two pyramids upon congruent bases may be proved equal by bringing them into congruence with each other. But suppose that they differ only in that one is the obverse of the other, so that they could be brought into congruence only by looking at one of them in a mirror and then placing the other into congruence with the image of the first as seen in the mirror. Would we detract from the rigor of the demonstration by assuming the possibility of such an obversion without changing the volume of the pyramid? With a fourth dimension we should have no detraction from rigor. We would simply obvert the pyramid as we would turn over the triangle.

The question of the fourth dimension as a reality may be considered from two points of view, its conceivability and its possible objective reality. If by conceivability we mean the power of being imaged in the mind it must be admitted that it is absolutely inconceivable. We have no difficulty in forming a visual conception of three lines passing through the same point, each of which is at right angles to the other two. Such is the familiar system of coördinate axes in space. But he who would conceive a fourth dimension must be able to imagine a fourth axis perpendicular to all three of the others. This clearly transcends all possibility even of imagination. The fourth dimension in this sense is certainly inconceivable.

The question of the objective possibility of the fourth dimension is quite a distinct one from that of its conceivability. The latter limitation upon our faculties grows out of the objective fact that we and our ancestors have had no experience of a fourth dimension; that we have always lived in a universe of three dimensions only. But we should not too readily conclude that all being is necessarily confined to these three dimensions. Those who speculate on the possible have taken great pleasure in imagining another universe alongside of our own and yet distinct from it. The mathematician has shown that there is nothing absurd or contradictory in such a supposition. But when we come to the question of physical fact we must admit that there appears to be no evidence of such a universe. If it exists, none of its agencies intrude into our own universe, at least in the opinion of sober thinkers. The intrusion of spirits from without into our world is a favorite idea among primitive men, but tends to die out with enlightenment and civilization. Yet there is nothing self-contradictory or illogical in the supposition. The fish that swims the

ocean experiences objects which, to him, seem to come from outside his universe, steamships for example. If our atmosphere had been opaque to the rays of light from the sun, or even if it had been so filled with clouds and vapor that we could never see outside of it, we also should have had a similar experience. But we may be said, in a certain sense, to see through the whole of our conceivable space with the aid of our telescopes, and the general tendency of scientific thought at the present time is toward the conclusion that no natural agency of which we can trace the operation originates outside the space into which our telescopes may penetrate. Our universe forms, so to speak, a closed system. This is true apparently even of agencies so subtle as those which give vibrations to ether. If there is any agency which we could imagine to connect us with an outside sphere it is certainly the luminiferous ether. But should this ether enter into a fourth dimension the intensity of light and radiant heat would diminish as the cube of the distance and not as the square. To speak more accurately, radiance emanating from an incandescent body would be entirely lost—would pass completely out of our universe. The fact that it is not lost, and indeed the general theory of the conservation of energy, shows that there is no interchange of energy between our universe and any possible one lying in another dimension of space.

We may regard the limitations of the dimension of space to three as expressing in a certain way a physical fact. Our conception of space is originally based upon the possibility of motion. The threefold posibility of relative motion can be reduced to a physical fact in this way. Let a point be fixed at one end of a rod, the other end of which is immovably fixed to a wall. The point can then have motion over the surface of a sphere whose center is at the fixed point and whose radius is the length of the rod. Now fix one end of a second rod to another point of the plane and bring the two ends of the rods together, and fix the point on both ends; then the point can only move in a circle. Fasten it to a third point of the plane with a third rod, and it cannot move at all. But if we add a fourth dimension it could move.

The limits of space are for us simply the limits of possible motion of a material body. We can imagine a body coming from any point in three dimensional space to us, but cannot imagine one coming from outside of such space, until we add a fourth dimension.

Our conclusion is that space of four dimensions, with its resulting possibility of an infinite number of universes alongside of our own, is a perfectly legitimate mathematical hypothesis. We cannot say whether this conception does or does not correspond to any objective reality. What we can say with confidence is that if a fourth dimension exists, our universe and every known agency in it is, by some fundamental law of its being, absolutely confined to three of the dimensions. But we must not carry a conclusion of this sort beyond the limits set by experience. When we say that experience shows that not only our material universe, but all known agencies in it, are, by a law of their being, incapable of motion in more than three dimensions we must remember that the conclusion applies only to those motions which our senses can perceive, the motions of masses, in fact. There is no proof that the molecule may not vibrate in a fourth dimension. There are facts which seem to indicate at least the possibility of molecular motion or change of some sort not expressible in terms of time and three coördinates in space. If we consider those conceptions of mechanics which we derive from visible phenomena to afford a sufficient explana-

tion of molecular action we must admit that, when the position and motion of every atom of a given substance are defined, the chemical properties of that substance are completely determined. If we take two collections of atoms of the same substance, put them together in the same way, and endow them with the same kinds of vibratory motion, we ought, on any mechanical theory of matter, to obtain substances of identical properties. Now, there seem to be reasons which I cannot stop at present to develop that might make us believe in changes of properties and attributes of substances not completely explained by molecular changes. That such is the case with vital phenomena can be demonstrated beyond doubt; that it is the case with chemical phenomena when they approach the vital character seems very probable. Certainly there is some essential difference between that form of molecular motion in which heat is commonly supposed to consist and the motion of masses. Perhaps the most remarkable of these differences consists in the relation of this motion to the ether. The motion of a mass suffers no resistance by passing through the ether with the highest astronomical velocities. Matter so rare as that of the diffuse comets may move around the sun with a speed of many miles per second without suffering the smallest resistance from the ether—in a word, without any friction between the matter and the ether. But when the molecules have the motion of heat, that motion, if motion it be, is always communicated to the ether, and is radiated away from the body, which thus becomes cool. Whatever form we attribute to the energy of heat, it is certainly a form which is constantly communicated from matter to the ether by a fundamental law of matter. Consequently, if heat be really a mode of motion, as is now generally supposed by physicists, it follows that there is some essential difference between the character of this motion and the motion of the smallest masses into which matter can practically be divided. The hypothesis of vibration in the fourth dimension merely suggests the possibility that this kind of motion may mark what is essentially different from the motion of masses. Of course, such an hypothesis as this is not to be put forward as a theory. It must be worked out with mathematical rigor, and shown to actually explain phenomena before we assign it to any such rank.

I cannot but fear that some confusion on this subject is caused by the tendency among both geometers and psychologists to talk of space as an entity in itself. As I have already said, a fourth dimension in space is nothing more than the addition of a fourth possibility of motion to material bodies. The laws of space are only laws of relative position. Certain fundamental axioms are derived from experience, not alone individual experience, perhaps, but the experience of the race, giving rise to hereditary conceptions born in the mind and corresponding to the facts of individual experience. A tree confined to one spot, even if it had eyes to see and a brain to think, could never have a conception of space. For us the limits of space are simply the limits to which we can suppose a body to move. Hence when space itself is spoken of as having possible curvatures, hills and hollows it seems to me that this should be regarded only as a curvature, if I may use the term, of the laws of position of material bodies in space. Clifford has set forth, with great acuteness and plausibility, that the minute spaces occupied by the ultimate atoms of matter may, in this respect, have properties different from the larger space which alone makes itself known to our conceptions. If so, we should only regard this as expressive of some different law of motion, or, since motion is only change of position, of some

different law of position among the molecules of bodies.

This consideration leads us to a possible form of space relations distinct from those of our Euclidean geometry, and from the hypothesis of space of more than three dimensions, I refer to what is commonly known as 'curved space.' The history of this conception is now so well known to mathematicians that I shall mention it only so far as is necessary to bring it to your minds. The question whether Euclid's axioms of parallels is really an independent axiom, underivable from the other axioms of geometry, is one which has occupied the attention of mathematicians for centuries. Perhaps the simplest form of this axiom is that through a point in a plane one straight line and no more can be drawn which shall be parallel to a given straight line in the plane. Here we must understand that parallel lines mean those which never meet. The axiom, therefore, asserts that through such a point we can draw one line which shall never meet the other line in either direction, but that if we give this one line the slightest motion around the point in the plane it will meet the other in one direction or the opposite. Thus stated, the proposition seems to be an axiom, but it is an axiom that does not grow out of any other axioms of geometry. The question thus arising was attacked by Lobatchevsky in this very conclusive manner. If this axiom is independent of the other axioms of geometry then we should be able to construct a self-consistent geometrical system, in conformity to the other axioms, in which this axiom no longer held. The axiom of parallels may be deviated from in two directions. In the one it is supposed that every two lines in the plane must meet; no line parallel to another can be drawn through the same point in the plane. Deviating in the other direction we have several lines drawn through the point which never meet the given line; they diverge from it as lines on an hyperboloid may diverge.

That such possibilities transcend our ordinary notions of geometrical relations is beyond doubt, but the hypothesis of their possibility is justified by the following analogy. Let us suppose a class of beings whose movements and conceptions were wholly confined to a space of two dimensions as ours are to a space of three dimensions. Let us suppose such beings to live upon or in a plane and to have no conception of space otherwise than as plain extended space. These beings would then have a plane geometry exactly like ours. The axiom of parallels would hold for them as it does for us. But let us suppose that these beings, without actually knowing it, instead of being confined to a plane, were really confined to the surface of a sphere, a sphere such as our earth, for example. Then, when they extended their motions and observations over regions so great as a large part of the earth's surface, they would find the axiom of parallels to fail them. Two parallel lines would be only two parallel great circles, and though each were followed in a direction which would seem to be invariable they would be found to meet on opposite sides of the globe. The suggestion growing out of this consideration is: May it not be possible that we live in a space of this sort? Or, to use what seems to me to be the more accurate language: May it not be that two seemingly parallel straight lines continued indefinitely would ultimately meet or diverge? The conceptions arising in this way are certainly very interesting. If the lines would meet it can easily be shown that the total volume of all space is a finite quantity. The sum of the three angles of a triangle extending from star to star would then be greater than the sum of two right angles. Equally legitimate is the hypothesis that it would

be less than three right angles, but in this case the total volume of space would still be infinite. Now, this is an hypothesis to be tested by experience. Unfortunately, we cannot triangulate from star to star; our limits are the two extremes of the earth's orbit. All we can say is that, within those narrow limits, the measures of stellar parallax give no indication that the sum of the angles of a triangle in stellar space differs from two right angles. If our space is elliptical, then, for every point in it—the position of our sun, for example—there would be, in every direction, an opposite or polar point whose locus is a surface at the greatest possible distance from us. A star in this point would seem to have no parallax. Measures of stellar parallax, photometric determinations and other considerations show conclusively that if there is any such surface it lies far beyond the bounds of our stellar system.

Such are the considerations by which it seems to me that speculations on this subject may legitimately be guided. The wise man is one who admits an infinity of possibilities outside the range of his experience, but who in considering actualities is not decoyed by the temptation to strain the facts of experience in order to make them accord with glittering possibilities. The experience of the race and all the refinements of modern science may be regarded as showing quite conclusively that, within the limits of our experience, there is no motion of material masses in the direction of a fourth dimension, no physical agency which we can assume to have its origin in regions to which matter cannot move, when it has three degrees of freedom. Claiming this, we must carry the claim only to the limits justified by actual experience. We have no experience of the motion of molecules; therefore we have no right to say that those motions are necessarily confined to three dimensions. Perhaps the phenomena of radiation and electricity may yet be explained by vibration in a fourth dimension. We are justified by experience in saying that the space relations which we gather from observation around us are valid for the greatest distances which separate us from the most distant stars. We have no right to extend the conclusion further than this. We must leave it to our posterity to determine whether, in either way, the hypothesis of hyper-space can be used as an explanation of observed phenomena.

S. NEWCOMB.

REPORT UPON SOME PRELIMINARY EXPERIMENTS WITH THE RÖNTGEN RAYS ON PLANTS.

SINCE it is a matter of some interest to know what influence, if any, the Röntgen rays would exercise on plants, I undertook a series of somewhat extensive preliminary experiments, to determine what lines of investigation might profitably be carried on should there be marked indications of any response to possible stimuli from this source.

The lecture room of our botanical department being connected by separate electric wire for the stereopticon, and the wire passing within a few metres of the end of one of the houses of the (*botanical*) conservatory, the current could be connected with the apparatus in the glass house with little trouble and expense. The connecting of the electric wires with the house was done under the direction of Professor H. J. Ryan, of the Sibley College of Mechanic Arts. An ordinary tin frame rheostat and an App's Coil were loaned by Professor E. L. Nichols, of the physical department, and the Crookes tubes used were of a pattern recommended by Professor Nichols, who, at the beginning of the experiment, set up the apparatus. To him I am indebted also for advice concerning the use of the apparatus, and also to Professor E. Merritt, of the physical department.

The portion of the conservatory employed for the experiments was the north end of one of the houses, where a bench space of about 2m. x 3m., and the height of the house, was enclosed as a dark room, by hanging black canton flannel and covering this on the outside and on the roof of the house with coarse cloths or board frames to exclude the light.

Experiment 1. Since in a number of cases the use of the Röntgen ray for exploring internal parts of the human body has resulted in certain injuries which are supposed to be due to some action of the ray, the first of the series of experiments which I conducted with plants was for the purpose of ascertaining if there was any marked injury which could be induced by an exposure of about one hour's time. Indeed, those with whom I discussed the matter prior to the investigations, and who were familiar with the use of the rays for other purposes, were inclined to think that distinct injuries would be produced. For the first experiment a potted Caladium about 60 cm. high was used. One leaf was supported directly in front of the bulb and about 10 cm. distant, while a flat metal key was suspended over the center of the leaf to intercept the rays at this point. The light was turned on at 11:07 a. m., June 6th, and a continuous run was made of 1 hr. 18 mins., *i. e.*, until 12:25 p. m. There was no visible effect at the close of the exposure and subsequently the leaf remained to all appearances normal.

Experiment 2. For the next experiment seedlings of corn, oats, German millet, sunflower and radish, which had been germinated in small 2-inch pots a few days before were used. The seedlings varied from 5 to 10 cm. in height. The pots were placed directly in front of the bulb, in such a manner that each kind of seedling was situated at different distances from the bulb in a radiating row. The experiment started at 1 p. m., June 6th. A piece of black canton flannel was tied over the bulb to intercept the electric light rays, so that their influence would not be felt, and this was kept over the bulb during all the subsequent experiments. At 2:45 p. m. it was noticed that the plants nearest the bulb were so close that electrical discharges took place between the bulb and the leaves, causing the plants to nod constantly toward the bulb and even to come sometimes in contact with it as the spark was formed. They were then moved to a distance of 15–20 cm. At nearly 4 p. m. all the plants were removed for a period of about three minutes while exposures were being made to obtain photographs. With this exception the seedlings were exposed to the influence of the Röntgen ray for a period of ten hours, the run being made from 1 p. m. to 11 p. m., when the dynamos were shut down for the night. No injurious effect was noticeable nor could any be detected later.

Experiment 3. The next experiment was started at 6 p. m., on June 6th. For this were used seedlings of corn, wheat, sunflower, radish, German millet and soja bean. The seedlings were grown in a dark room and were, therefore, etiolated, and varied from 8 cm. to 20 cm. in height. The plants were exposed that evening continuously for five hours. The wheat, German millet and corn seedlings were so frail that they drooped in various directions. At 9 p. m. it was noticed that the seedlings of the soja bean were turned slightly toward the bulb, while at the beginning of the experiment they were turned away from it. No perceptible injury took place.

Experiment 4. A potted begonia plant was placed so that the delicate flowers hung in front of the bulb within 10 cm. and remained there for five hours. There was no perceptible injury at the close of the run; nor on any subsequent days could injurious effects be observed.

Experiment 5. A potted plant of Caladium was placed with the leaf within 20 cm., with a small piece of sheet lead so placed between it and the bulb as to intercept a portion of the rays. The exposure continued for five hours. At the close of the experiment, and subsequently, no change could be observed.

Experiment 6. On June 8th a large number of seedlings which had been started previously in soil contained in wooden trays were placed in front of the light and exposed for several days. The seedlings used were those of corn, oats, wheat, radish, sunflower, soja bean, white lupine, cucumber, vetch, pea, German millet and cotton. There were several duplicate sets of the seedlings for this experiment; one lot was planted June 1st and the other June 5th, to provide seedlings in different stages of growth. From some which were just germinating they ranged in size to those which were 10 cm. high. The following gives the facts concerning the condition of the seedlings on June 8th, at the time of starting the experiment:

LOT 1. PLANTED JUNE 1ST.

NAME OF PLANT.	CONDITION JUNE 8TH.
Sunflower	5—8 cm.
Wheat	8—10 cm.
German millet	3 cm.
Nonpareil bean	just coming through the soil.
Soja bean	5 cm.
Cotton	just coming through the soil.
Oats	8—10 cm.
Corn	5—8 cm.
Vetch	5—8 "
Pea	2—5 "
Cucumber	2—4 "

LOT 2. PLANTED JUNE 5TH.

NAME OF PLANT.	CONDITION JUNE 5TH.
Cotton	germinating.
Wheat	germinated.
Sunflower	nearly up.
German millet	germinated.

The boxes containing the seedlings were so arranged that some of the seedlings were very near the bulb, while others were at varying distances, to the front, and right and left, so that if any distinct influence was manifested the extent of the field of this influence could be easily determined, and its degree, to some extent, be measured by the effect on the plants at varying distances. The field was explored with a fluoroscope to be certain that the rays reached all the plants which were placed in front of a line a few centimetres in advance of the bulb. A check lot of the seedlings was placed behind the instrument in the dark room in which the experiments were being conducted, so that they might grow under exactly the same conditions, except that they would not be under the influence of the Röntgen rays.

The experiment was started at 11 a. m., June 8th. The run was continued until 11 p. m., but since the interrupter in connection with the coil did not work satisfactorily the circuit was permanently broken at intervals. During this period the current was on about one-half the time. The following day, June 9th, the interrupter continued to work unsatisfactorily, and finally broke down at 5 p. m., the current having been turned on at 8 a. m. During the day of June 9th the instrument was running about one-fourth of the time. The interrupter was repaired and the current was started again at 10:20 a. m., the following morning, June 10th, and a continuous run was made up to 11 p. m., June 11th, the run was continuous from 8 a. m. until 11 p. m., and on June 12th, Saturday, from 8 a. m. to 4:30 p. m., when this experiment was discontinued.

During all of this time the plants behaved exactly as one would expect them to in an ordinary dark room. Those which had not come above the soil before they were placed under the influence of the Röntgen rays were entirely etiolated, while the new growth of shoots and leaves on

those which had attained some growth before the beginning of the experiment was also etiolated, the shoots being slender and the leaves small. The leaves, which were green at the start, gradually became nearly or quite yellow. The wheat, oat and millet seedlings were so weak that they fell prostrate, lying in all directions. At times it appeared as if the rays might have some peculiar taxic influence, since some of the seedlings were turned, now in one direction and at a later time in another, but there was no constancy in any of these movements, and they were ascribed to nutation. In fact, seedling plants which were in the path of the Röntgen rays for a period of over forty-five hours during five days did not at the close of the experiment appear in the least different from those in the same dark room, but which were out of the reach of the rays, and there was no appreciable difference in behavior during the continuance of the experiment.

That the seedlings were susceptible to directive influences of ordinary daylight was shown by their behavior when the dark compartment was opened. At one time the compartment was opened by parting two of the hanging dark curtains for about two minutes. Two hours afterward, when the compartment was again opened, nearly all the plants were turned strongly toward this point. This appears to me to be an interesting illustration of the great sensitiveness of these etiolated plants to light, and proves the fact that the response to the stimulus occurs some time subsequent to the stimulus.

The plants used in this experiment were now placed in normal light, and were observed carefully for several days. All of the etiolated plants gradually became green, but it was noticeable that those which were not under the influence of the Röntgen rays recovered more rapidly, though the difference was not very striking. This suggests that there may be some subtle injurious influence on the chloroplastids of the plant.

Experiment 7. The next experiment was started on June 14th, at 9 a. m. The dark cloth had been removed for the purpose of growing seedlings under the Röntgen rays which were at the same time exposed to normal daylight. The seedlings were arranged in front of the bulb in the same way as described for experiment 6. The following seedlings were used: squash, wheat, oats, pea, vetch, cow pea (*Dolichos*), sunflower, radish, soja bean, nonpareil bean and cotton. The seeds were planted a few days in advance, so that they were just coming through the ground in various stages when the experiment was started. A run of fourteen hours was made on June 14th, and of nine hours on June 15th, when this experiment terminated. No influence whatever from the Röntgen rays was observed.

In 1896 Schober* published the results of some experiments with the Röntgen rays on seedlings; these were undertaken for the purpose of determining if short exposures to the rays would produce taxic movements in the nature of curving or bending of the seedlings. Young oat seedlings were used which had been germinated in a dark room, and they were enclosed in a small geotropic chest, blackened both on the inner and outer side. This was so placed that they were at a distance of two cm. from the bulb at the opening of the chest. They were exposed for one half hour, and after a short interruption for another half hour. No turning had taken place. In order to see if the seedlings were sensitive to the light they were then placed near a small opening in the side of the room, and in the course of an hour perceptible heliotropic movements began, which were more marked

*Schober, A. Ein Versuch mit Röntgen'schen Strahlen auf Keimpflanzen. Ber. d. deutsch. Bot. Gesell. XIV., 108-110, 1896.

at the close of two hours, when they stood at an angle of 60°. He concludes from his experiments that the Röntgen rays have no taxic influence on seedlings.

Experiment 8. Three species of Mucor were sown in dilution cultures in nutrient agar-agar, in Petrie dishes. After the spores had begun to germinate one culture of each was placed within 25 cm. of the bulb, and the rays were then intercepted from one-half of each culture by a piece of sheet lead. A duplicate set of the cultures was placed out of reach of the rays. The cultures were exposed for four hours, and returned to the culture room. No difference in growth was perceptible, the Röntgen rays neither inhibiting nor hastening growth.

Experiment 9. Several forms of chromogenic bacteria were then subject to the influence of the rays. Several tube cultures in nutrient agar-agar were placed within 10 cm. of the bulb for about four hours. A duplicate set was kept in the same house, but outside of the field covered by the Röntgen rays. From each of the two sets of cultures inoculations were made into fresh nutrient media. There was no perceptible difference in growth nor in the color as a result of the exposure to the rays.

Experiment 10. A motile bacillus, *B. communis*, was next placed within 15 cm. of the bulb. The cultures were made in bouillon and poured into Petrie dishes. Two Petrie dish cultures were employed, and the rays were intercepted from one-half of each by sheet lead. They were exposed six hours. From each half of the two cultures then one drop was carried to the third dilution, and four cultures were then made from each of the second and third dilutions in nutrient agar, and distributed in Petrie dishes in order to compare the number of colonies. The results showed no difference in the proportionate number of bacilli in the two halves of the Petrie dishes. The rays, therefore, have no influence on the distribution of the bacilli in the liquid, nor on their vitality for the length of time exposed, a fact which Professor Marshall-Ward had already demonstrated.

Experiment 11. A species of motile Oscillatoria was distributed in six watch glasses with a small amount of water, the threads being arranged in a tangled mass in the center. Two of these were placed within 8 cm. of the bulb, two others at a distance of 20 cm. with the Röntgen rays intercepted by sheet lead, and the other two placed outside of the dark room. The experiment began at 12:30 p. m. and was discontinued at 4:30 p. m. In all the vessels during this period of four hours the threads moved out in a radiating fashion from the center, and some had moved partly up the sides of the vessels. In one of those exposed to the influence of the rays the thread had moved farther than in any of the others, while in the other five vessels no difference in the extent of the movement was observed, and the greater movement of the threads in one of the two exposed to the rays could probably be accounted for on other grounds.

Experiment 12. The influence of the rays was next tested on sensitive plants, *Mimosa pudica*, grown in pots. Two plants were used, and both were jarred, so that the leaves dropped on their petioles and the leaflets closed in pairs. The larger one, *a*, was placed so that the nearest leaves were within 10 cm. of the bulb after the dark room had been dispensed with. The smaller one was placed in another portion of the same house, but where the daylight was of the same intensity, so far as the eye could judge. In twenty minutes the leaves of the two plants had opened somewhat, but *b* had opened more than *a*, which was within the field of the rays. The plants were then jarred a second time, and inter-

changed, *b* being placed under the rays. Ten minutes later *b* had opened slightly, while *a* had not opened at all; the sun by this time, 6 p. m. (June 12th), having passed below the top of a western building. While I intended at the time to repeat this experiment on the following day, the result shows quite conclusively, I think, that the difference manifested by these two plants in the rapidity of opening was due to individual peculiarities rather than to any influence of the Röntgen rays. For while it would at first appear that they exercised a slight inhibitory influence, the interchange of the plants shows that this was due to the more rapid response of the plant *b* to the influence of daylight.

In Schober's experiments the question as to whether the seedlings, or any parts of the plant, readily absorbed the Röntgen rays was not studied. From time to time, during the continuance of my own experiments, the field was explored with the fluoroscope to be certain that the rays were being evolved, and also an occasional photograph of the hand was made as a test of the strength of the rays. Good photographs were thus obtained with an exposure of from four to five minutes at a distance of 20 cm. to 25 cm. During the close of the first week's experiments the Crookes tube gradually deteriorated because of the high vacuum produced by prolonged use. This was first manifested in the resistance offered by the tube to the passage of the electric current. It was also manifested in some of the photographs taken at the time, the plates being affected unevenly, which indicated that the rays were given off more strongly in some directions than others. This bulb was discarded on June 12th, and a new one substituted on June 14th. Since it is well known that the Röntgen rays pass quite readily through wood the non-absorption of the rays by the plants might explain the absence of any marked influence upon them. Consequently, this subject received some attention, and attempts were made to obtain Röntgen photographs of some of the plants experimented upon, as well as of some other plant parts. The greater number of the exposures were made by placing both the sensitive plate and the object inside an ordinary card box, in which the plates are sold, a thin sheet of white paper being placed between the sensitive film and the object. A plate of a high sensitometer was used.

The first object used was an oak leaf (*Quercus rubra*). This was exposed, first for four minutes and a second time for three minutes. The leaf selected was a rather young and succulent one, thus being more difficult to photograph by transmitted light, but the older and firmer ones were too large for the size of plate used. The oak leaf was exposed for a longer time than would have been necessary if the method employed for a majority of the photographs, described above, had been followed in this case. Here, however, an ordinary plateholder was used, and a black rubber slide not only lay over the plate, but another was placed over the leaf, which was on the outside, to hold it in place. While in both of these cases an outline of the leaf and of the more prominent veins was obtained, better results were had when the exposure was made in an ordinary cardboard box. Here a fairly good outline of the leaf and of its venation was obtained. It is also to be observed that in the shorter exposure, which is needed for these delicate objects, a picture is also obtained of the structure of the box, the thin paper which is pasted on the outside, and overlaps the edges, showing quite plainly. Röntgen photographs of five seedlings which had for several days been under the influence of the rays were made. These were cotton, pea, nonpareil bean and soja bean, the cotton and one of the nonpareil

bean seedlings being grown entirely under the rays. Good outlines of the leaves and tracings of the principal veins were obtained, while the stems, roots and cotyledons of the pea and beans made strong pictures. The contrast between the general groundwork of the leaves and the surrounding space is quite strong, which shows that there was considerable absorption of the Röntgen rays even by the delicate seedlings experimented upon, and that the absence of any marked injury or other influence could not be due to non-absorption of the rays.

The other plant parts which were photographed by the Röntgen rays are the following: Leaves of two species of Begonia, in which quite strong pictures of the leaves and of the venation were obtained. The venation of B, rex, with rather prominent red veins coming out more strongly than B, nitida-alba, both were being taken on the same plate. The interior of various nuts, as almond, peanut, hickorynut, makes quite strong pictures. Good pictures were obtained of the endosperm (prothallium), of the fruit of cycas, also of the seeds of green peas and beans still within the pod. Flower buds of Fuschia show the pistill and stamens in position before opening and the delicate flowers of Begonia also absorb the rays sufficiently to be photographed, although the picture made was weak. Fruits of apricot and green fruit of the plum and pea absorb the rays so strongly that it is difficult to get a good contrast between the flesh and stone, while the ripe fruit of a black cherry (probably a variety of *Prunus avium*) gives better contrast. The placenta and young ovules of *Podophyllum peltatum* show rather indistinctly through the walls of the ovary. A knot in the pine board makes a distinct Röntgen photograph. The spadix and flowers of *Arisæma triphyllum* show distinctly through the spathe, and the vascular ducts of the stem are also photographed. In specimens of Peltandra, in which the spadix was entirely enclosed within the spathe the spadix and outlines of the staminate and pistillate flowers are quite distinctly shown in a Röntgen photograph, while the vascular ducts of the stem show quite strongly in the picture (see Plate I., Frontispiece).

It is thus seen that plant tissues absorb the Röntgen rays quite freely, and it is singular that there is not a more marked influence on growing parts, especially that there are no visible external injuries, even when the parts are exposed at close range a large part of the time during several days, since the general impression is that the rays, even with comparatively short exposures, are injurious to the human tissues.

The longer my experiments continued the more mysterious the whole subject seemed. On a dark night, when the electric-light rays were intercepted by a black screen, exploring the field with a fluoroscope there was an abundance of light, flashing and quivering with the variations in the electric transmission through the tube, penetrating, and yet capable of absorption to a considerable degree. That it should present no easily discernible influence for the time during which the work continued was cause for profound surprise.

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*SOME CONSIDERATIONS UPON THE FUNCTIONS OF STOMATA.**

THE sporophytes of many Bryophyta and of all Pteridophyta and Spermatophyta have their epidermis pierced with minute openings known as stomata. These occur upon particular portions of the aërial structures, not being found upon roots, nor upon subaqueous stems and leaves. They always stand over masses of chlorophyll-bearing

* Read before Section K. of the British Association for the Advancement of Science, August 19, 1897.

cells, and communicate directly with their intercellular spaces.

Every stoma is more than a mere slit between the epidermal cells. It is, in fact, a simple organ consisting of two active cells, the 'guard cells,' between which is the elongated opening. By changes in shape the guard cells narrow or broaden the opening, or completely close it.

It has been found that gases and water-vapor pass through the open stomata. In the case of gases the passage is in either direction, while it appears that the water-vapor passes in one direction only, namely, from the intercellular spaces outward. From the fact that the stomata serve for the passage of both gases and water-vapor have arisen two views as to their proper function, some botanists holding that they are organs of respiration, that is, breathing pores, while others regard them as transpiration organs, that is, organs for permitting the escape of surplus water from the tissues of the plant. According to the first view the stomata are connected directly with the process of photosyntax and the metabolic changes which follow it, in other words, with the supply of carbon to the plants, while according to the second view they are connected with the supply of inorganic salts to the ash constituents of the plant. Since the passage of water-vapor through the stomata is a much more noticeable phenomenon than the ingress or egress of gases, it is quite natural that at first the former should be considered as the primary function. With this view have come corresponding explanations of the purpose of transpiration, involving much of the discussion of nutrition in the treatises on plant physiology. If stomata are organs of transpiration, then transpiration is a physiological phenomenon of much importance, and it behooves us to find out why plants have developed organs for its promotion.

In considering the questions involved, it is well to remember that terrestrial plants which possess stomata have developed from aquatics none of which have stomata. These aquatics, living in the ocean or the fresh-water rivers and lakes, must supply themselves with all their food constituents from the water and the substances it holds in solution. In the simpler plants every cell absorbs these directly from the surrounding water, and this is true of the larger plants also, with slight modification. We must not, however, overlook the fact that water itself is an indispensable constituent of every cell, not as food, but as a part of its mechanical structure. More than nine-tenths of every active cell is water, upon whose presence the activity of the cell is dependent. In aquatics this necessary water is supplied directly from the surrounding medium, and since there is no loss of water each cell easily maintains all that it requires.

Terrestrial plants must supply their cells with the necessary food constituents, and must, also, maintain in them the proper amount of water. Every cell in a terrestrial plant must be turgid with water in order to be active, and if this be impaired the plant suffers. The maintenance of the water supply is thus of the greatest importance in terrestrial plants. Accordingly, the roots are always in communication with water in the soil from which they obtain their supply. The cells of the stems and leaves must obtain their water by absorbing it from the turgid root-cells. Now, these cells in the stems and leaves not only have no direct access to water, having to obtain their supply indirectly, at second hand as it were, but they are surrounded by a medium which is drier than they, so that they are constantly losing water by evaporation. This loss of water is usually greater than the scanty supply from the water of the soil, and accordingly the aërial parts of plants are protected by a layer of

cuticularized cells, the epidermis. The drier the air in which a plant grows the thicker the epidermal layer, an extreme case occurring in the Burro Thorn (*Holocantha emoryi*) of the arid regions of southern Arizona, where there are from three to five layers of cells in the epidermis. That plants are able to protect themselves against very dry air is shown by the fact that even in excessively dry climates there are many species which are able to live and form flowers and seeds.

But with the change from the aquatic to to the terrestrial habit there came a division of labor in the organs of absorption. The roots now absorb water and solutions, while the stems and leaves absorb carbon dioxide. And here arises a difficulty: The epidermis which prevents the escape of water-vapor also prevents the absorption of carbon dioxide. This difficulty was surmounted by the formation of stomata. A leaf without stomata, or what is the same thing, with its stomata permanently closed as with wax, will not lose water, but it will starve for want of carbon dioxide. These stomata are open as long as there is no danger of such a water loss as would result in loss of turgidity, but when the cells show an approach to flaccidity the stomata close. While open there may be a free interchange of gases, carbon dioxide entering and being absorbed by the chlorophyll-bearing cells, but while this is going on there is certain to be a considerable loss of water, especially if the air be dry. On every dry day land plants lose much water, since they must have their stomata open in order to obtain their supply of carbon dioxide.

Aërial plants, as many Tillandsias and Orchids, do not differ in any essential respect from terrestrial plants. They must have enough water to keep their cells turgid, and, at the same time, their chlorophyll-bearing cells must be supplied with carbon dioxide. They invariably grow in moist climates, where the constant moisture of the air is supplemented by frequent drenching rains. Under such conditions many terrestrial plants would be able to live and grow for some time. At the same time it is to be observed that many aërial plants have a greatly thickened epidermis, or have their surfaces covered by a coat of dry hairs. They evidently have taken some precautions to guard against harmful water loss.

It is not too much to say that the facts cited above indicate that respiration is the normal function of stomata, and that the loss of water through stomata is incidental and secondary. Some experimental results may be cited here.

a. Stahl has shown that when the stomata are closed no starch is made,* showing that the carbon dioxide must enter by the stomata.

b. Blackman concludes that "practically the sole pathway for carbon dioxide into or out of the leaf is by the stomata."†

c. Stahl has shown that transpiration takes place through the stomata, and this only when they are open.‡

d. Observations often repeated by many physiologists show that the stomata of many cultivated plants close quickly when the supply of water to the roots is deficient, and that plants in dry climates have remarkable devices for preventing the loss of water.

e. Stahl has shown§ that in many evergreen plants the stomata close during the period when there is no carbon assimilation.

f. It is a well known fact that stomata are usually open in sunlight, when carbon-assimilation (photosyntax) is possible.

g. Plants from which carbon assimila-

* *Bot. Zeit.*, 52: 127–133 (1894).

† Phil. Trans. Roy. Soc. London, 186, B: 485 (1895); from abstract in *Bot. Gaz.*, 20: 336.

‡ *Bot. Zeit.*, 52: 117–127 (1894).

§ l. c.

tion is absent have greatly reduced numbers of stomata, as in the dodders (Cuscuta) and the little mistletoes (Razoumofskya), while they are present in abundance in green parasites (Viscum and Phoradendron).

From the foregoing rapid and quite summary survey of the different phases of this question we are warranted in concluding:

1. That one of the functions of stomata is the admission of carbon dioxide to the chlorophyll-bearing tissues of the plant, for use in the formation of the carbohydrates.

2. That the loss of water by terrestrial plants was originally hurtful, and is so now in many cases.

3. That if plants have utilized this constant phenomenon it is for the supply of food matters of secondary importance, as the salts in solution in the water of the soil.

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*RECENT PROGRESS IN AGRICULTURAL CHEMISTRY.**

I.

Since the last *résumé* of progress in agricultural chemistry was reported to this body a considerable advance has been made in our knowledge of the methods and means of nitrogen assimilation. The most marked progress has been made along the line of the inoculation of seed and the soil with nitrifying ferments. Much has been done in this direction, and the results of the experiments are sufficiently encouraging to warrant the belief that much good may yet come to agriculture by following out this line of investigation. In 1895, in the Yearbook of the Department of Agriculture, the following statements occur :

"It may not be long until the farmer may apply to the laboratory for particular nitrifying ferments to be applied to such special purposes as are mentioned above. Because of the extreme minuteness of these organisms the too practical agronomist may laugh at the idea of producing fertility thereby, and this idea, indeed, would be of no value were it not for the wonderful facility of propagation which an organism of this kind has when exposed in a favorable environment. It is true that the pure cultures which the laboratory affords would be of little avail if limited to their own activity, and it is alone in the possibility of their almost illimitable development that their fertilizing effects may be secured."

It cannot be said that the prophecies foreshadowed in the above quotation have been fully verified, but at least something has been accomplished.

From the time that it was demonstrated by Hellriegel and Wilfarth that the power which leguminous plants possess of increasing their stores of nitrogen was due to the bacteria inhabiting nodules on their rootlets, the study of this phenomenon has been pushed with great vigor in all parts of the world. Intimately related, as it is, to the nitrifying organisms of the soil, it has, nevertheless, been demonstrated that the two species of bacteria, the general nitrifying species and the special so-called symbiotic species, inhabiting the roots of plants, are entirely different in their nature, and that their activity is not mutually convertible.

The most extensive experiments in the direct inoculation of the soil with nitrifying ferments have been conducted by Dr. Salfeld, of Lingen, in Hanover. The greater part of the experiments has been made on peaty soils, as it is in such soils that the greatest deficiency of nitrifying organisms is observed. An excellent review of Dr. Salfeld's work has been pub-

* Prepared at the request of the officers of Section C, of the A. A. A. S., and read before Section C and the American Chemical Society at the Detroit meeting, August, 1897.

lished by N. H. J. Miller, in the Journal of the Royal Agricultural Society of England, Vol. 7, third series, part 2, pp. 236 *et seq.*

The method employed by Dr. Salfeld was to spread upon the peaty soils large quantities of soils in which peas, beans and other leguminous crops had been grown. Immense quantities of the soil to be used to develop the fertilizing ferments were required; quantities ranging from 16 to 32 hundred weight per acre were used, and it was found that the larger quantities gave the better results.

The particular bacterium which is most active in developing nodules on plants has been called the *Bacillus radicicola.* It was found in Dr. Salfeld's experiments that there exist many peaty soils which are so poor in this bacterium as to require inoculation with other soils containing it before leguminous crops can be grown successfully.

As was to be expected, the most striking results were obtained with soils which were most deficient in the nitrifying bacillus, and when the inoculation was accompanied with the addition of a sufficient quantity of lime, phosphoric acid and potash. The large quantities of soil which are required for the direct inoculation, as outlined above, have rendered of great interest the attempts to secure inoculation in a more direct and positive manner. This has led to a study of the possibilities of securing pure cultures of nitrifying organisms which can be applied directly to the seed before planting, or can be mixed with moderate quantities of soil and thus distributed over a large area.

The most extensive experiments in the processes of seed inoculation have been carried on by Professor Nobbe, of Tharand, Saxony. The principle of these inoculations is first to secure the pure cultures of the bacteria inhabiting the nodules of the roots. These pure cultures are obtained by the ordinary bacteriological processes now so well known. With these pure cultures inoculations of various kinds have been practiced, viz., inoculations of the soil itself, inoculations of the exterior of the seed, and inoculation by pricking the seed with needles bearing the germs of the pure cultures.

The remarkable fact has been developed that while the bacteria derived from the pure cultures of the root nodules of various legumes appear to be microscopically identical they, nevertheless, have very distinct characters. The results of these experiments have shown that in inoculation best results are obtained when plants of the same species and, as nearly as possible, the same family are used. Even among the Leguminosæ, when passed from one species to another, the vitality of the organism is either diminished or entirely destroyed. This is illustrated, for instance, in attempts which have been made to inoculate the members of the pea family with the bacteria taken from the roots of clover, or *vice versa.* The commercial outcome of these experiments is that these cultures have been prepared on a large scale for general sale. While the idea of thus preparing fertilizers in a practically infinitesimal quantity for field work is not a new one, and is not lacking in its appeals to the imagination, it cannot be said that the practical results have been fully equal to the expectations which have been aroused.

The commercial name of these preparations is nitragin, although, etymologically, probably the term nitrogene would have been preferable, but it was necessary to distinguish it in some way from the name of the element.

The Imperial Seed Control Station at Vienna made experiments with 100 kilograms of soil taken from a field where lupines had been grown, and 20 kilograms of analogous soil coming from a field where

serradella had been grown. These soils, which were to be used for inoculation, were taken from portions of the field where the roots were abundantly provided with the usual nodules. The soil selected for inoculation by these samples was sandy, poor in humus and rich in lime with a gravelly subsoil.

The inoculations which were made have shown that the lupines and serradellas, which, up to that time, had never been developed successfully in the fields where the experiments were made, in spite of most careful culture, showed a remarkable growth in comparison with the plots which were not inoculated. The serradella which was inoculated directly with the nitragin did not respond to this inoculation, but peas inoculated with the nitragin showed a remarkably luxuriant development of the plants, with the formation of radical nodules, in comparison with the plants cultivated at the same time and not inoculated. It is necessary, however, that these experiments with inoculation be repeated for several years before definite conclusions in regard thereto can be drawn. (l'Engrais, Vol. 12, 1897, p. 351.)

Experience has shown that preparations of nitragin do not retain their vitality indefinitely and, in order to secure the best results, should be used as soon as possible after manufacture. It is evident also that the particular source from which each sample of nitragin is prepared must be designated, and the farmer wishing to use it as a fertilizer must purchase those varieties which are suited to the crop he wishes to grow ; otherwise, he may make the mistake of applying nitragin derived from peas or beans to a clover field, or the contrary.

An excellent review of the methods of preparing nitragin and the processes of its application is given by J. Augustus Voelcker, in the Journal of the Royal Agricultural Society of England, Vol. 7, third series, part 2, pp. 253 *et seq*. The method of obtaining the pure cultures of the nitrifying bacteria is as follows:

A plate of prepared gelatin is inoculated from the nodules of the leguminous plants containing the living bacteria. A second plate is inoculated from one of the colonies formed in the gelatin plate. This process is continued until a pure cultivation is obtained, due to one particular species of nitrifying organism.

In preparing nitragin for commercial use the pure cultivation, obtained as above, is placed in a bottle, holding from 8 to 10 ounces, containing a small quantity of agar gelatin on which it is allowed to grow. The bottle is sealed and the contents kept in the dark. Up to the present time nitragin has been prepared from 19 different kinds of leguminous plants. Each bottle, when sealed, has a different colored label according to the kind of crop it is intended for, and also the German and botanical name of the plant. The contents of a single bottle are sufficient for securing the inoculation on an acre and a-half of land on which the crop is to be grown and are sold for about 65 cents. In appearance, as a rule, the bottle seems to be filled to the depth of one and a-half inches with a light brown jelly in which may be noticed a white growth or mold. Care must be taken that the temperature of the mixture be not raised above blood heat and that the bottle be not exposed for any length of time to strong light. A moderately high temperature and exposure for any length of time to intense light destroy the vitality of the organism.

The nitragin may be used directly on the the seeds which are to be sown, which, on germinating, develop radicles on which the organisms grow. In the inoculation of the seed the contents of the bottle of nitragin are liquefied by gentle warmth and poured into half a liter of lukewarm water. Any

residual jelly in the bottle is dissolved by shaking it with the water. When the jelly has been thoroughly distributed throughout the water the seeds to be inoculated are sprinkled thoroughly and worked well together so that a portion of the moisture is attached to each seed. The seeds are dried by mixing with some fine earth taken from the field in which they are to be sown.

The best method of applying nitragin is to at first introduce it into a sufficient quantity of moist earth, which is subsequently thoroughly stirred from time to time until the organisms have had time to multiply and distribute themselves in great numbers throughout the whole mass. This moist mass, dry enough, however, to permit of its being thoroughly stirred without caking, is applied to the field either by sowing broadcast or in ordinary drills such as are employed in the distribution of fertilizers. While, as has been said, the first effects have not been so good as have been anticipated, there is sufficient evidence to warrant the belief that the use of nitragin may in the near future become commercially valuable. This leads to the hope that we may find speedily verified the prediction which I made some four or five years ago to the effect that the nitrifying organisms of the soil, in the form of reasonably pure cultures, would eventually be used for fertilizing principles. The seeding of the soil with appropriate nitrifying ferments is certain to become as much of an exact science as the use of the proper ferments in butter and cheese making, in the curing and fermentation of tobacco and in other commercial operations where the activity of bacteria conditions the character and value of the product.

Mazé has recently shown that the life of bacteria resident in the nodules of the Leguminosæ is not a pure symbiosis. It has been demonstrated by this investigator that where artificial conditions, suited to the nourishment of these bacteria, are provided, they are able to oxidize free nitrogen in an environment from which all plant life is rigidly excluded. The bouillon in which the bacteria were cultivated was obtained from white beans. To this bouillon 2.5 per cent. of sugar and 1 per cent. of common salt and a trace of bicarbonate of soda were added. The bouillon was solidified by the addition of 15 per cent. of gelose and was spread in layers 4 millimeters thick on the botton of glass dishes about 20 centimeters in diameter. These vases were so disposed as to be supplied with a current of air from which every trace of oxidized nitrogen was removed and which had been subjected to a high temperature for a sufficient length of time to entirely sterilize it. This was accomplished by passing it through a tube containing metallic copper heated to low redness but not high enough to sensibly diminish the content of oxygen in the air. It was then conducted through a tube filled with broken glass saturated with sulfuric acid for the purpose of absorbing any ammonia, next through a bottle containing sterilized distilled water to saturate the air with the vapor of water, whence it passed to the dishes where the cultures were made. In five days it was found that the sugar of the broth was all consumed and that the quantity of oxidized nitrogen in the bouillon had been more than doubled.

Thus it was proved that the bacteria of the Leguminosæ, placed in a medium resembling as nearly as possible that in which they naturally live, are capable of oxidizing free nitrogen without any symbiotic help of any kind. If these deductions of Mazé be verified by subsequent investigators, it will prove that the nodules in which these bacteria reside are only convenient places in which they exercise their activity, which is entirely independent of the vital activity of the plant which they inhabit.

The sources of the first organic nitrogen

suitable to the nourishment of plants have been the subject of investigation in many quarters. It has been established with a considerable degree of certainty that the nitrifying organisms are capable of existing on the surface and even to a considerable depth in the interior of bare rocks at high altitudes where even the mosses and lichens fail to grow. It is evident, therefore, that these organisms have a great deal to do in the incipient stages of vegetable life and in the preparation of the first particles of humus, which is the substance distinguishing soil from finely cominuted rocks. Later investigations show also that nitrogen exists in combination with metals, as metallic nitrids, as has been shown by the investigations of Hillebrand and others. Among other metallic nitrids that of thorium has been detected. Notable quantities of mineral nitrogenous compounds have been found in the carnallit coming from the Stassfurt mines. As much as .018 per cent of ammoniacal nitrogen has been found in these salts. The artificial carnallit is richer in ammonia than that of nature. It is evident that in carnallit the ammonia replaces a small portion of the potash.

In regard to the origin of this ammoniacal nitrogen, it is generally understood that it comes from the decomposition of the living beings which peopled the sea whose evaporation produced the saline deposits. The ammoniacal nitrogen which is present in the primitive rocks, however, cannot be ascribed to this source, since these rocks were formed at an epoch when life did not exist upon the surface of the earth. This ammoniacal nitrogen, as has been said, occurs almost uniformly as metallic nitrids. It was doubtless, therefore, the first form of nitrogen used to nourish the beginnings of animal and vegetable life, since it existed before any of these forms could, by their decomposition, have furnished available nitrogen for plant growth. This ammoniacal nitrogen, therefore, must have served directly to nourish the first forms of life and thus to have helped lay the foundations of the whole vegetable world. (l'Engrais, Mar. 12, 1897 ; Apr. 9, 1897.)

A heated discussion has arisen between the French and German schools of agriculture in regard to the harmfulness of the denitrifying organisms found in soils and manures. Wagner urges the importance of sterilizing stable manure in order to prevent the loss of nitrogen that would otherwise be brought about by the organisms contained in it. Deherain, on the other hand, declares that this precaution is unnecessary when stable manure is applied to ordinary soils in the usual quantities.

Comparatively little attention has been given to the isolation and study of pure cultures of the nitrate-destroying organisms found in soils, manures, straw and fodders. While their existence has been repeatedly proved and their behavior in mixed cultures has been studied by Gayon and Dupetit, Springer, Deherain and Maquenne, Breal and others, the first denitrifying organisms obtained in pure cultures and accurately described were those reported by Burri and Stutzer in 1895. These investigators found a denitrifying organism in horse manure which they called *Bacillus denitrificans I.*, and which they found to rapidly destroy nitrates when growing in the same culture with *B. coli communis.* They also isolated and described, under the name of *B. denitrificans II.*, a denitrifying organism from straw.

A second denitrifying organism was found in horse manure by Schirokikh early in 1896, while more recently an organism of this class was found in cow manure by Ampola and Garino.

Considerable progress in our knowledge of the denitrifying ferments in soil has been made by Ewell in the Division of Chemistry, Department of Agriculture, in

investigations not yet published. He has separated and begun the study of three organisms that rapidly destroy nitrates with the formation of free nitrogen. One was obtained from a sample of soil, another one from pig manure and the third one from hen manure. The first two belong to the class of organisms which liquefy gelatine and produce a green or yellowish green fluorescent pigment. They belong to the same or closely related species. For comparison of these organisms, cultures of all similar organisms obtainable have been procured from the bacteriological laboratories of the United States Marine Hospital Service and of the Surgeon-General of the Army. The organisms thus far examined in regard to this property are the following: Two cultures from different sources of *B. pyocyaneus*, two of *B. fluorescens liquefaciens* and one each of *B. pyocyaneus*, *B. pyocyaneus D.* and *B. pyocyaneus pericarditidis*.

From the description given by Schirokikh of the organism found by him in horse manure it would appear that it is also of this class.

The study of the organisms isolated by Ewell will be continued and reported at the proper time; the investigation is to be extended to include soils of the various types, the feces of all the domestic animals, and various fodders, etc., in order that we may develop as fully as possible our knowledge of the nature and habitat of all organisms possessing the power to reduce nitrates with the liberation of free nitrogen.

Numerous bottles of nitragin have been received in this country, and I believe experiments are now in progress in many of our experiment stations in its use. The practical demonstrations which have been made, however, of its utility have been made at European stations, and many of the results which have been obtained in this country have not yet been published. Many interesting contributions to the literature of the subject will doubtless come from our own stations in the near future. Important work has already been done in studying the nodules of leguminous plants in many of our stations, especially in those of Massachusetts, Louisiana and Illinois.

(*To be concluded.*)

H. W. WILEY.
DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

THE AMERICAN SOCIETY OF NATURALISTS.

THE annual meeting of the 'Naturalists' and 'Affiliated Scientific Societies' was held at Cornell University, Ithaca, New York, December 28, 29, 30, 1897. The mild weather and attractive surroundings, together with the unbounded hospitality of the people of Ithaca and an excellent program and large attendance, combined to make the meeting more than usually successful.

In the absence of the President, Professor Whitman, of the University of Chicago, the chair was occupied by Professor S. F. Clarke, of Williams College, one of the founders of the Society. After listening to the Report of the Treasurer, action was taken on certain items of business.

Communications from the President of Columbia University, the President of the American Museum of Natural History, and the Secretary of the New York Academy of Sciences, inviting the Society to hold its next meeting in New York City, were read and referred to the Executive Committee. The Society subsequently decided to accept the invitations from New York.

It was reported that President McKinley was about to appoint a commissioner to serve in the place of Mr. John J. Brice and, in view of the present deplorable condition of the scientific work of the Commission, the following resolutions were unanimously adopted :

"*Resolved*, That the American Society of Naturalists, as representatives of the principal scientific and educational interests of this country, unanimously express to the President and Congress of the United States their sentiment that the Commissioner of Fish and Fisheries should, according to the law of 1888, governing his appointment, be 'a person of proved scientific and practical acquaintance with the fish and fisheries of the coast.'

"*Resolved*, That it is of the utmost importance that the Fish Commission, as one of the most useful scientific institutions of the government, should be free from political influence and should be administered with the highest degree of scientific efficiency by an experienced officer."

It was then voted that Professor H. F. Osborn, of Columbia University, be a delegate to convey the resolutions of the Society to the President of the United States, and the members were asked to urge their Congressmen to prevent the appointment of any person unfitted for the place. The keen interest that was manifest in the discussion is a guarantee to Mr. McKinley that if his appointment is in accord with the spirit of the law he will gain the active support of scientific men throughout the country.

Professor T. H. Morgan stated that the 'American Tables' at Naples were quite inadequate to the needs of American students, and that were it not for the unlimited generosity of Professor Dohrn many Americans could not have availed themselves of the privileges of the Zoological Station. Professor Osborn said that a friend of Columbia University had offered two hundred and fifty dollars towards the five hundred necessary for the support of an additional table, and Professor John B. Smith moved that the Society appropriate one hundred dollars to be added to that already in the hands of Professor Osborn. It was so voted. It was also voted that that fifty dollars be appropriated for the continuance of the 'Naturalists' Table' at Woods Holl.

An amendment to the constitution, providing for the extension of the territory in which the Society may meet, was actively discussed, but failed of the number of votes necessary for its passage. The members then listened to the annual discussion on 'The Biological Problems of To-day:'

Paleontology.	Professor H. F. Osborn, Columbia University.
Botany.	Professor Wm. Trelease, Missouri Botanic Gardens.
Anatomy.	Professor Burt G. Wilder, Cornell University.
Psychology.	Professor J. McKeen Cattell, Columbia University.
Physiology.	Professor Jacques Loeb, University of Chicago.
Developmental Mechanics.	Professor T. H. Morgan, Bryn Mawr College.
Morphogenesis.	Professor Charles B. Davenport, Harvard University.

Each participant was limited to ten minutes and the papers were short and to the point. They will be printed in full in this JOURNAL at an early date. Special papers were presented by Professors Osborn, Williams and Wilder.

The following officers were elected for 1898:

President.—H. P. Bowditch, Harvard Medical School.

Vice-Presidents.—Professor Wm. James, Harvard University; Professor S. H. Gage, Cornell University; Professor H. S. Williams, Yale University.

Secretary.—Professor H. C. Bumpus, Brown University.

Treasurer.—Professor John B. Smith, Rutgers College.

Executive Committee.—Professor J. P. McMurrich, University of Michigan; Professor E. G. Conklin, University of Pennsylvania.

The annual dinner, given at Cascadilla Place, was a thoroughly enjoyable occasion. Professor Osborn presided in the absence of Professor Whitman, who, being unavoidably detained, was unable to give the address on 'Some of the Functions and Features of a Biological Station,' that he had

prepared. It will be published in an early issue of SCIENCE.

H. C. BUMPUS,
Secretary.

BROWN UNIVERSITY, PROVIDENCE, R. I.

SCIENTIFIC NOTES AND NEWS.

THE meeting of the American Society of Naturalists at Ithaca, reported above, was unusually well attended, owing to the large number of affiliated societies meeting with it. In addition to the Physiological Society, the Morphological Society and the Psychological Association, which met last year at Boston, there was not only the Association of Anatomists, which last year postponed its meeting till the spring, but there were also two new societies—the Association for Botanical Morphology and Physiology, and Section H., Anthropology, of the American Association. The proceedings of all these societies, which will be fully reported in this JOURNAL by the Secretaries, were crowded with excellent papers. The meeting at New York next winter will undoubtedly be the most important in the history of the American Society of Naturalists and affiliated societies.

THE Royal Society has received, through Professor Anderson Stuart, telegraphic information that the expedition sent out to bore a coral reef at Funafuti has returned to Sydney, having carried the bore down to 698 feet, without reaching the bed rock.

AT a meeting of the Board of Managers of the National Geographic Society on December 31, 1897, Alexander Graham Bell was elected President of the Society. This election fills the vacancy occasioned by the death of Mr. Gardiner G. Hubbard.

THE Parkin Prize of the Paris Academy of Sciences has been awarded to Dr. A. D. Waller, of London, for his investigations on the relations of nervous activity and carbon dioxide. The prize is of the value of about $600.

M. RAMBAUD, French Minister of Education, Senator, and professor of contemporary history at the Sorbonne, has been elected a member of the Academy of Moral Sciences, in the room of the late Duc d'Aumale.

THE Berlin Academy of Sciences has appropriated three thousand Marks for the publication of a map of the Arabian desert of Egypt.

THE office of Astronomer Royal of Ireland, and the professorship of astronomy in the University of Dublin, has been conferred upon Mr. C. J. Joly, fellow of Trinity College.

WILLIAM HARPER, Chief of the Bureau of Information of the Philadelphia Commercial Museums, has returned to Philadelphia after a trip around the world taken in the interest of the Museums.

THE death is announced of Dr. Friedrich A. T. Winnecke, who some years ago made important contributions to the astronomy of position at the observatories at Bonn, Pulkova and Karlsruhe. On the establishment of the University of Strassburg, at the end of the Franco-German War, he was made director of the observatory, but his health broke down, and since that time he has been unable to accomplish any scientific work.

WE regret also to record the deaths of the following men of science: M. Imbault Huart, the French Consul at Canton, at the age of forty years, who was a high authority on the languages and geography of the Far East, especially of Formosa, on which he published an elaborate work; Dr. Giacomo Sangalli, professor of pathological anatomy in the University of Pavia, and Senator of the Kingdom of Italy, aged 76; Dr. Franz Ritter von Schneider, professor of chemistry in the University of Vienna.

GROUND was formally broken for the Museum Building of the New York Botanical Garden by President Samuel MacMillan, of the Department of Public Parks, on December 31st, with a nickel-plated pick and shovel presented to him at the site for the purpose by Messrs. Parker and Parshley, of the John H. Parker Co., contractors, in the presence of Messrs. Fallows and Ward, representing Mr. R. W. Gibson the architect, and Dr. Britton, Mr. Henshaw and Mr. Nash, of the Garden staff, and others. Appropriate remarks were made by President MacMillan and by Dr. Britton. The contract for the construction and equipment of the Museum Building, Power House and minor buildings has been awarded by the

Commissioners of Parks to the John H. Parker Company for $347,019.00. The plans for the great range of horticultural houses have been completed, and specifications for them have been printed. We hope to publish illustrations and descriptions of these and of the Museum Building in an early issue. The sum of $15,-000.00, in addition to the funds provided by the Act of Incorporation, has been made available for the building of portions of the driveway system. During the past season about 2,900 species of plants have been obtained, together with large quantities of Museum, Library and Herbarium material.

THE trustees of the British Museum have decided to discontinue the opening of the exhibition galleries on week-day evenings from 8 to 10 p. m. after the close of the year, and, instead, to keep them open (in alternate sections) until 6 p. m. all the year round. The evening opening commenced in February, 1890, on the installation of the electric light, but the attendance has been too small to warrant the continuation. The arrangements for opening on Sunday afternoon have not been altered.

THE schooner 'Prosper' has arrived at San Francisco with about 240 fur-seal skins from the Galapagos Islands. It is a pity that Ecuador has taken no steps to protect what is left of the once valuable rookeries on these islands, which, with proper care, might have been brought in time to a paying basis. Of course, every catch like that of the 'Prosper' lessens the possibility of so doing and increases the length of time it would require. The species, *Arctocephalus townsendi*, is only known to science through a few skulls obtained by Mr. Townsend some years ago when the seals were not on the rookeries.

THE Secretary of the Treasury has issued regulations under the Act of Congress prohibiting the taking of seals by American citizens, except on the Pribyloff Islands, and forbidding the importation into this country of pelagic sealskins. The regulations provide that no sealskins, raw, dressed, dyed or otherwise manufactured, shall be admitted to entry in the United States, except there be attached to the invoice a certificate signed by the United States Consul at the place of exportation that said skins were not taken from seals killed within the waters mentioned in said act, specifying in detail the locality of such taking, whether on land or at sea, and also the person from whom said skins were purchased in their raw and dressed state, the date of such purchase and lot number. Consuls shall require satisfactory evidence of the truth of such facts by oath or otherwise before giving any such certificate.

A NEW laboratory for physical chemistry at the University of Leipzig was formally opened on January 3d, if the program was carried out.

MR. JOHN MILNE writes to *Nature* that arrangements have been made for the establishment of horizontal pendulums, with photographic apparatus to record unfelt movements, at Toronto, Harvard, Philadelphia, Victoria, B. C., New Zealand (two), Batavia, Madras, Calcutta, Bombay, Mauritius, the Cape, Argentina, San Fernando and Kew, while a number of other stations are under consideration. Seismograms have already been received from Toronto. At his station on the Isle of Wight, for purposes of comparison, Mr. Milne has also two horizontal pendulums writing on smoked paper, and very shortly a Darwin bifilar pendulum is to be established. To this will be added later a von Rebeur-Paschwitz apparatus, with which type of apparatus Mr. Milne worked for many years in Japan.

IN 1889 the late Francis B. Hayes placed all his property in trust, providing that at his death it might be willed to such charitable corporations as he might select. He made the Massachusetts Horticultural Society his residuary legatee, and as there was some doubt as to whether this could be regarded as a charitable organization the matter was brought before the Court. Judge Allen has decided that the bequest was permissible, and the Horticultural Society will receive $300,000, as well as $10,-000 left to it directly.

THE Massachusetts Board of Agriculture has authorized an inspection of the spread of the brown-tail moth, which was first discovered in Cambridge and Somerville last spring, and it has been found that it has spread greatly to

the northeast. The Board has no means at its disposal for exterminating the pest, but has notified the owners or managers of some 1,900 estates of the law of 1897, which says that "it shall be the duty of the owners and managers of premises infested with this moth to exert themselves persistently to confine and suppress it," and have furnished them with a bulletin describing the pest and giving directions for its destruction.

THE nomenclature of the new New York City parks, relative to which there has been much discussion, was fittingly determined at a recent meeting of the Park Commissioners by the selection of the following: Alexander Hamilton Park, John Jay Park, De Witt Clinton Park, William H. Seward Park and Hamilton Fish Park. It had been suggested, as we noted in a recent issue, that the name of the late W. A. Stiles, a former Park Commissioner, should be associated with one of the new pleasure grounds, but the precedent of naming a park in honor of any Park Commissioner was wisely deemed a bad one. The fostering care of science and art, and the distinguished services rendered the city and the nation by the eminent men whose names have been chosen, make the decision one which will meet with universal approval. All lovers of nature will be particularly gratified by the graceful recognition of De Witt Clinton.

THE Astley-Cooper prize of the value of £300, awarded biennally by Guy's Hospital, will again be given at the beginning of 1901, the subject being the 'Physiology of the Pancreas.'

THE United States Civil Service Commission announces that, on February 7, 1898, an examination will be held to establish an eligible register from which a selection may be made to fill a vacancy in the position of keeper of aquarium at the National Zoological Park at a salary of $75 per month. The examination will consist of a light educational test, together with practical questions on the habits, distribution and classification of fishes, including translations of descriptions of fishes from German and Latin into English.

THE Friday evening meetings of the Royal Institution will begin on January 21st at 9 p. m., when the Right Hon. Sir John Lubbock, Bart., M. P., will give a discourse on 'Buds and Stipules.' Succeeding discourses will probably be given by Professor C. Lloyd Morgan, Mr. Alan A. Campbell Swinton, Dr. John Hall Gladstone, Professor L. C. Miall, Captain Abney, Professor T. E. Thorpe, Mr. James Mansergh, the Very Rev. the Dean of Canterbury, Professor Dewar and others. To these meetings members and their friends only are admitted. Lord Rayleigh will deliver lectures after Easter.

THE fifth annual lecture course of the Linnæan Society of New York City, in coöperation with the American Museum of Natural History, will be given in the large lecture hall of the Museum, Seventy-seventh street and Eighth avenue, as follows:

January 6th, 'Cats and the Lands they Inhabit,' by DANIEL GIRAUD ELLIOT, F. R. S. E., Curator of Zoology, Field Columbian Museum. February 3d, 'From Vera Cruz to Mexico City,' by FRANK M. CHAPMAN, Assistant Curator, Vertebrate Zoology, American Museum of Natural History. March 17th, 'The Mammals of North America,' by ERNEST SETON THOMPSON; illustrated by views from nature and from original drawings by the lecturer. April 7th, 'Protective and Directive Coloration of Animals,' by C. HART MERRIAM, M. D., Chief of Biological Survey, U. S. Department of Agriculture.

THE Garden and Forest Publishing Company announce that with the last issue, which completes the tenth volume, the publication of *Garden and Forest* will be suspended. They state that "For ten years the experiment has been tried of publishing a weekly journal devoted to horticulture and forestry, absolutely free from all trade influences, and as good as it has been possible for us to make it. This experiment, which has cost a large amount of time and money, has shown conclusively that there are not persons enough in the United States interested in the subjects which have been presented in the columns of *Garden and Forest* to make a journal of its class and character self-supporting. It is useless to expend more time and money on a publication which cannot be made financially successful, and must, therefore, sooner or later cease to exist."

M. BRUNETIÈRE has retired from the editorship of the *Revue des deux Mondes*, the great

French literary journal. This is a matter of some scientific interest, as M. Brunetière had changed the journal from a liberal to à clerical organ, and while professing to use scientific methods in literary criticism had adopted an attitude somewhat hostile to modern science.

PROFESSOR O. TASCHENBERG has retired from the editorship of *Die Natur* and has been succeeded by Professor Willi Ule. The journal, published weekly by the Schwetschke'sche Verlag at Halle, was founded forty-six years ago, under the editorship of Dr. Otto Ule and Dr. Karl Müller. It maintains an excellent standard of popular science, being neither technical nor trivial.

THE publication department of the *Progrés Medicale* offers the complete works of Charcot, in thirteen vols. for 50 fr., reduced from 188 fr.

MESSRS. STUDER BROS. announce 'Chapters on the Natural History of the United States,' by Dr. R. W. Shufeldt. The pictures are reproduced from a series of photographs, made from life by the author.

A NEW monthly periodical, *Archives de Médicine des Enfants* will hereafter be edited by Dr. J. Comby and published by Masson, Paris.

MR. JONAS STADLING, who contributed to the November *Century* an account of Andrée's expedition, sends to the January number a facsimile of a message from Andrée, sent by the aëronaut by carrier pigeon.

IN *Nature* for December 7th an article on the beaver park of Sir Edmund Loder gives interesting information regarding the beavers of Sweden. It appears that they are mainly confined to the Stifts of Christiania and Christiansand, although a few remain in Bratsberg Amt and Slavanger Amt. They feed on the bark of deciduous trees, not touching the firs. As they are unable to dam the swift streams of Sweden, they make their burrows at right angles to the bank, running inward and upward for some distance, so that when the rivers rise the beavers go higher up in their burrows. In 1880 there were about 60 animals left, but being protected they increased to 100 by 1883. Since 1894 a law has been passed protecting them for a period of ten years.

A SKELETON of the moa, *Dinornis* or *Euryapterix emeus crassus*, the extinct giant bird of New Zealand, was purchased recently at auction in London by Dr. Hutchinson for 48 guineas. It is said that most of the skeletons exhibited in museums are made up from different species. The present specimen was set up by Captain F. W. Hutton, F.R.S.

THE United States Coast and Geodetic Survey will send the steamship 'McArthur' to the waters of Alaska to make, when spring opens, a thorough survey of the coast, especially about the mouth of the Yukon River. A small steamer will also be taken to aid in the surveying work and to serve for the navigation of rivers too shallow for the 'McArthur.'

AT the recent international congress of publishers, held at Brussels, a recommendation was made that is of special interest to men of science, and should be insisted upon by them in arrangements with their publishers. The resolution was to the effect that a mere new printing of a book should be called a *tirage*, and not a new edition, unless it has been revised by the author.

THE metric system of linear measurement has now been in use in the English engine building works of Messrs. Williams & Robinson four years. Captain Sankey reports in the London *Engineer* that the draughtsmen are unanimously pleased with its working, and that the workmen, at first strongly opposed to its introduction, now greatly favor it. The manager finds it easier to teach the new than the old system.

AT an extra meeting of the Chemical Society, London, held at Burlington-house on December 15th, Professor Francis R. Japp, F.R.S., delivered a memorial lecture in honor of the distinguished German chemist, Friedrich August Kekulé, whose death occurred last year. After giving a sketch of Kekulé's life, Professor Japp said, according to the report in the London *Times*, that his supreme merit lay in his contributions to theoretical chemistry. His greatest achievements in this department were the doctrine of the linking of atoms in terms of their valency, and, growing out of this, the theory of the structure of organic molecules, both in open-chain and in closed-chain compounds. These were not recondite theories, hidden

away in the depths of the science; on the contrary, they were organic chemistry itself, and learnt by students on their first introduction to the subject. The lecturer proceeded to give an account of the genesis of some of Kekulé's theories and their relation to the work of other investigators. His memoir on the benzene theory, which was referred to as the crowning achievement of the doctrine of the linking of atoms, was the most brilliant piece of scientific prediction to be found in the whole range of organic chemistry. What Kekulé wrote in 1865 had since been verified in every particular, and not only had the various substitution derivatives been discovered in the number and with the properties required by the theory, but various observations that appeared to contradict it had been proved erroneous. Moreover, it had shown itself capable of boundless development, and there seemed no limit to the fruitfulness of Kekulé's conception of closed chains. Even in the undeveloped state of the subject prior to this theory, the facts were apparently so intricate and so unconnected that few chemists could claim to have mastered them. The theory appeared; the previously unmarshalled facts fell into their proper places, and, further, it became possible to say whether in any given section of the subject the facts were complete or only fragmentary. The debt which both chemical sciences and chemical industry owed to Kekulé's benzene theory was incalculable. As regards the former, three-fourths of modern organic chemistry was directly or indirectly the product of the theory, and as to the latter the industries of the coal-tar colors and the artificial therapeutic agents in their present form and extension would be inconceivable without the inspiration and guidance of Kekulé's fertile idea. By the accuracy of his predictions he had done more to inspire chemists with a belief in the utility of legitimate hypotheses in chemistry, and had, therefore, done more for the deductive side of the science than almost any other investigator. His work stood preëminent as an example of the power of ideas. A formula, consisting of a few chemical symbols jotted down on paper and joined together by lines, has supplied work and inspiration for scientific chemists for an entire generation and afforded guidance to the most complex industry the world had yet known.

THE scientific work accomplished by the Prince of Monaco, in the *Hirondelle* up to 1889, and since then in the *Princesse Alice*, has developed so greatly that the last named yacht has been found too small for the proper carrying out of these researches. As we learn from *Industries and Iron*, a larger yacht will be built for the continuation of the work. It will be a fast vessel, propelled by engines of 1,000 indicated horse-power, and designed to ensure a speed of 12 knots. She has a length between perpendiculars of 225 feet, with 34 feet beam, a depth of 20 feet, and her tonnage is 1,270 tons. The hull is built of steel, divided into seven water-tight compartments extending the upper deck. The cabin accommodation will be extensive, there being separate cabins for the scientific staff and a large laboratory.

THE *British Central Africa Gazette* states that reports from the West Shiré and Ruo districts give reason to believe that rinderpest has made its appearance among the game in both those districts. Game is said to be dying in numbers in the Elephants' Marsh—one of the game preserves formed by the administration of the Protectorate for the purpose of preventing the extermination of wild animals in this part of Africa. Prompt measures, it is said, have been taken to endeavor to prevent the introduction of the disease into the Shiré Highlands..

UNIVERSITY AND EDUCATIONAL NEWS.

THE Executive Committee of the Board of Trustees of the New York City College have accepted the plans of the new buildings presented by Mr. George B. Post. The estimated cost is about $1,200,000. The plans include provision for a chapel with a seating capacity of over 2,000, a library that will hold 70,000 books, a museum of natural history, laboratories, etc. The building, which will be of the English Collegiate Gothic style of architecture, will stand on a high elevation. It will be on Convent Avenue, St. Nicholas Terrace and 138th and 140th streets.

MR. LEVI BARBOUR, of Detroit, one of the regents of Michigan University, has donated

$15,000 toward an art building for the university, providing a $100,000 building shall be erected on the campus within six years.

BY the will of the late Susan S. Clark, of Hartford, Conn., just admitted to probate, Trinity College is to receive $10,000 for the support for two scholarships.

THE library of the University of Missouri has received a gift of about 2,000 volumes, chiefly on physics and chemistry, from Dr. A. Linton, of St. Louis.

A FELLOWSHIP, to be called the Geoffrey Fellowship, of the value of £100 a year for three years, has been presented to Newnham College, Cambridge, and will be awarded in June, 1898. The Geoffrey Fellow will be required to reside at Newnham College, and to pursue independent study in some department of learning, letters or science.

THE committee of the Charing-cross Hospital Medical School has passed the following resolution: "That the committee of the Charing-cross Hospital Medical School respectfully urges the government to introduce, early in the ensuing session, a bill on the lines of the London University Commission Bill, 1897. Further, the committee hopes that on this occasion the government will give sufficient time and support to the bill to insure its passing through both Houses of Parliament."

AN election to the Isaac Newton studentship of Cambridge University will be held in the Lent term, 1898. The studentship, which is of the annual value of £200, is for the encouragement of study and research in astronomy (especially gravitational astronomy, but including other branches of astronomy and astronomical physics) and physical optics. The persons eligible are Bachelors of Arts of the University who will be under the age of 25 years on January 1, 1898.

THE University of Zurich has 713 students, of whom as many as 333 are foreigners. 135 of these are from Russia. There are more women than men in the medical department.

THE Quain professorship of physics in University College, London, will be vacant at the end of the present session by the resignation of Professor Carey Foster. Candidates for the chair should send their applications by Tuesday, March 1st. 'The Curators of Patronage' of the University of Edinburgh announce that candidates for the chair of moral philosophy, vacant by the death of Professor Henry Calderwood, must send in their applications not later than March 31st.

DISCUSSION AND CORRESPONDENCE.

WATER SURFACE TEMPERATURES OF LAKE TITICACA.

TO THE EDITOR OF SCIENCE: A few observations of the temperature of the surface waters of Lake Titicaca, made during a recent trip across the lake, may be of interest to the readers of SCIENCE.

Lake Titicaca lies on the elevated plateau of Titicaca, partly in Peru and partly in Bolivia, at an altitude of 12,505 feet above sea-level. Its large size, its altitude, and the climatic conditions of the region in which it is situated, together with the historical associations connected with it, combine to make it in many respects the most interesting lake in the world. The following observations—unfortunately very incomplete—were made during the steamboat trip from Puno, situated on the Bay of Puno, at the western end of the lake, to Chililaya, a small village near the southern extremity of the lake. Chililaya, the landing place for passengers and freight going to La Paz, is about 100 miles from Puno, and 36 miles by carriage road from La Paz.

The steamer left Puno at 8 a. m., November 26th, and reached Chililaya at 7:30 p. m., the same day. At 8 a. m., before leaving the wharf at Puno, the air temperature was 56.0° and the water 60.9°. There were at that time scattering cirrus clouds, and a gentle breeze from NE. The air and water temperatures during the remainder of the day were as follows: 9 a. m., air, 50.0°; water, 59.5°. 10 a. m., air, 53.2°; water, 59.0°. 11 a. m., air, 51.8°; water, 57. 2°. 12m., air, 51.2°; water, 57.7°. 1 p. m., air, 50.9°; water, 57.9°. 2 p. m., air, 54.2°; water, 58.2°. 3 p. m., air, 54.8°; water, 58.3°. 4 p. m., air, 54.1°; water, 57.9°. 5 p. m., air, 49.8°; water, 57.9°. 6:15 p. m.,

air, 53.5° (in lee of land); water, 57.8°. The conditions of sky and wind during the day were a light to fresh breeze from N E, and scattering cirrus clouds or clear sky over the lake. These observations, incomplete as they are, are of some interest. The higher temperature of the water near shore, where the lake is shallow, and in the Bay of Puno, which is pretty well cut off from the main body of the lake; the slight diurnal variation of temperature, reaching a maximum at 3 p. m., and the prevailingly higher temperature of the water surface over that of the air, are facts that seem to be rather clearly indicated as far as this one set of observations is concerned.

On November 28th, during the return trip of the steamer, observations of air and water surface temperatures gave the following results: 7 a. m., air, 52.1°; water, 56.5°. 8 a. m., air, 51.1°; water, 57.0°. 9 a. m., air, 51.9°; water, 57.1°. 10 a. m., air, 56.7°; water, 57.7°. 11 a. m., air, 52.5°; water, 58.2°. 12 m., air, 55.1°; water, 57.9. 1 p. m. (outside Bay of Puno), air, 57.7°; water, 59.5°. 2 p. m. (in Bay of Puno), air, 62.1°; water, 60.4°. 5 p. m. (at Puno mole), air, 49.0°; water, 62.0°. The meteorological conditions during the day were an overcast sky (cirro-stratus) and light southeast wind, or calm, till 11 a. m., when the wind changed to northeast, and gradually increased, with increasing cloudiness (alto-stratus and cumulo-nimbus) until it reached about twenty-five miles an hour. The sky remained dark and threatening during the rest of the afternoon, but the wind died down soon after 4 p. m. The water temperatures show the diurnal increase up to 11 a. m., after which hour, owing probably to the increasing cloudiness and the change in wind direction, there came a fall in temperature in the open lake. In the Bay of Puno, as on the outward trip, the temperatures were higher than in the main body of the lake. Throughout the day, except at 2 p. m., the air temperature was below that of the water.

The clouds noted during the two trips across the lake were also interesting. On the first day, during the whole of which the sun was shining brightly, there was a very active growth of cumulus clouds over the mountains bordering on the lake. These clouds were first noted at 8:15 a. m. It was very noticeable, during the entire day, that the cumuli were over the land, where the rapid warming of the surface gave rise to ascending currents of air, and not over the lake, the sky over the water remaining clear, or showing light cirrus only. This phenomenon is very commonly noted in the neighborhood of large bodies of water, as in the case of our own Great Lakes. Another fact of interest was that the cumuli were better developed over the eastern shore of the lake, where the mountains are higher, than over the western shore, which is lower. During the morning the cumuli developed rapidly into cumulo-nimbus clouds, whose tops, blown southwestward over the lake, soon broke off from their bases, and dissolved as they descended to lower levels, being no more supported by ascending currents of air from below. About 2 p. m. the cumuli reached their greatest development, and at 4:30 began rapidly to dissolve into long lines of degraded cumuli. The height of the latter at 5 p. m., determined by reference to the heights of the Bolivian Andes behind them, was about 15,000 feet above sea level. It was noted that there was a considerable development of cirrus over the cumuli during the morning hours of this day, thus indicating a relation between the cumulus, formed at a lower level in the ascending current, and the cirrus, formed at a second higher level. At this second level, as explained by Abercromby, the diminished amount of vapor which the ascending current contains after the formation of the cumulus reaches its second condensation point, and a second layer of cloud, the cirrus, is formed.

As yet no careful study has been made of the meteorology of the Lake Titicaca district, and nothing definite can be said as to the influence of this body of water upon the climate of the surrounding country. There can, however, be little doubt that the lake must modify this climate to a considerable extent, although the surrounding mountains would confine this influence to the immediate vicinity of this lake.

R. DEC. WARD.

HARVARD COLLEGE OBSERVATORY,
AREQUIPA, PERU, December 1, 1897.

ZIRKELITE—A QUESTION OF PRIORITY.

In the *Mineralogical Magazine*, Vol. XI., pp. 86–88 (read June 18, 1895) is described a new mineral containing zirconium, titanium, lime, iron, etc., under the name of Zirkelite. This paper was prepared by my friend Dr. E. Hussak and Mr. G. T. Prior.

Later Mr. Prior (l. c., pp. 180–183, Read Nov. 17, 1896) published an analysis of the same mineral.

I wish to protest against the use of the name Zirkelite for this mineral on the ground of the prior use of it to designate a commonly occurring rock belonging to the basaltic family.

When two subjects are so intimately connected as mineralogy and petrography it does not seem to be for the interest of science that names should be duplicated in them. So true is this that I abandoned the name Rosenbuschite, which I had given to a class of rocks in honor of Professor Rosenbusch, because only a few weeks previously it had been employed to designate a new mineral.

The term Zirkelite was used by me in 1887, or seven years before it was taken by Messrs. Hussak and Prior. (See Preliminary Description of the Perioditites, Gabbros, Diabases and Andesites of Minnesota. Bulletin No. 2, Geological Survey of Minnesota, 1887, pp. 30–32.) It was used to designate the commonly occurring altered conditions of basaltic glassy lavas which are often called diabase glass, etc. Zirkelite occurs forming the entire mass of thin dikes, and the exterior parts of many dikes of diabase and melaphyr, as well as the surface of old lava flows like the melaphyrs and diabases of Lake Superior, Newfoundland and elsewhere. Zirkelite holds the same relation to tachylite that diabase and melaphyr do to basalt, *i. e.*, an older and altered type. The macroscopic and microscopic characters of this rock were given in the locality cited above.

The term Zirkelite was again used in the same way in my Report to the Geological Survey of Michigan for 1891–1892 (1893, pp. 30, 97, 138, etc.).

It was also published in my classification of rocks given in the Catalogue of the Michigan College of Mines (Michigan Mining School) 1891–1892, p. 104; 1892–1894, Table XI.; 1894–1896, Table XI.

Further, the term Zirkelite is defined in accordance with my usage in Loewinson-Lessing's Petrographisches Lexikon, 1893, p. 252; and accounts of it are given in the Neues Jahrbuch für Mineralogie, 1893, II., p. 292, and in Kemp's Handbook of Rocks, 1896, p. 170.

M. E. Wadsworth.

Michigan College of Mines,
Houghton, Mich., December 17, 1897.

SCIENTIFIC LITERATURE.

Catalogus Mammalium tam viventium quam fossilium. Dr. E. L. Trouessart. New Ed. Fascic. II., Carnivora, Pinnipedia, Rodentia (Protrogomorpha and Sciuromorpha), pp. 219–452, June, 1897. Fascic. III., Rodentia (concluded), pp. 453–664, Oct., 1897. Berlin, R. Friedländer und Sohn. Price, $2.50 each part.

The second and third parts of Trouessart's 'Catalogue of Mammals, living and fossil,' have come to hand and carry the work through the Carnivora and Rodentia. These parts are less satisfactory than the first, and cannot be said to represent the present state of knowledge of the groups treated, particularly with respect to American forms. Among the latter many synonyms are accorded full specific rank, many good species are degraded to synonymy, and many forms are transposed in a manner that shows an absence of appreciation of their affinities. And when it comes to the geographic distribution of American species the most astonishing inaccuracies creep in, as might be expected.

In matters of nomenclature Dr. Trouessart seems to be a law unto himself, and consistency does not seem to be one of his canons. In using Brisson he quotes the pre-Linnæan edition (1756), which has no status in nomenclature, instead of the edition of 1762; while in quoting Linnæus he takes the opposite course and uses the 12th edition (1766) instead of the 10th (1758), which is accepted the world over as marking the beginning of Zoological nomenclature. With respect to Brisson's genera it will be interesting to know what rules, if any, led to the adoption of *Hydrochœrus* and the re-

jection of *Odobænus*, *Glis** and others. If all had been rejected his course would have had the merit of consistency and would be defensible. The generic name *Trichechus* is erronously applied to the Walrus instead of the Manatee.

Dr. Trouessart is a most diligent searcher of the literature and is to be congratulated on the freedom of his catalogue from omissions. Most of the errors here pointed out are such as are bound to creep in in an undertaking of this character and magnitude, and the reviewer wishes it understood that in calling attention to them he has not done so in a spirit of criticism, but for the purpose of rendering the work more useful.

The authority for the generic name *Bassariscus* is Coues, 1887, not 'Rhoads, 1894.' The genus *Wagneria* Jentink, 1886, cannot stand. It is not only the same as *Bassariscus*, but is preoccupied.

Thalassarctos Gray, 1825, is antedated by *Thalarctos* of the same author and based on the same animal.

Lyncus Gray, 1825 (first printed *Lynceus* by Gray in 1821), is antedated by *Lynx* Kerr, 1792.

The name *Ictis* Kaup, adopted for a subgenus of Weasels, is preoccupied by *Ictis* Schinz, 1824, for which reason *Arctogale* Kaup will have to stand for the Weasels. This I have already published in SCIENCE (Vol. V., p. 302, Feb. 19, 1897); and since *Arctogale* Peters, 1864, is preoccupied by *Arctogale* Kaup, 1829, I proposed the new name *Arctogalidia* for the palm civets, of which *Viverra trivirgata* is the type (see SCIENCE as above).

Ursus piscator Pucheran, 1855, and *U. beringiana* Middendorff, 1851, given as forms of *U. arctos*, are based on the same animal.

Ursus emmonsi Dall, given as a 'variety' of *U. americanus*, is certainly a most distinct species.

* In the case of *Glis* it is stated in a footnote that the genus cannot be admitted because Linnæus had previously instituted the order *Glires*, and because Brisson did not use binomial nomenclature. The first reason is trivial and not in accord with any code of nomenclature; the second, if considered a valid objection by the author, should have caused him to reject *Hydrochœrus* also.

A most unfortunate slip is the reintroduction of Peale's generic name *Cricetodipus* (a synonym of *Perognathus*) for the Kangaroo rats of the genus *Perodipus*, in accordance with an ill-advised suggestion from Mr. Rhoads. But Mr. Rhoads carefully abstained from giving Peale's measurements of his type specimen, which prove beyond question that the animal could not have been a Kangaroo rat. The hind foot measured '$\frac{8}{10}$ inch'—a trifle less than 20.5 mm., which agrees with young specimens of *Perognathus* from the plains of the Columbia, in Oregon and Washington. A nursing young Kangaroo rat (*Perodipus columbianus*), from the same region, has a hind foot measuring 36 mm. and a total length more than double that given by Peale for his *Cricetodipus*.

Among the 12 Kangaroo rats of the genus *Dipodomys* given full specific rank, one (*similis*) is a synonym (of *simiolus*) and three (*ambiguus*, *simiolus* and *parvus*) are subspecies (of *merriami* Mearns). In the sequence given, these subspecies are not only accorded specific rank, but with one exception are removed from the forms to which they are most closely related and placed after members of widely different groups. Similarly, the large *Dipodomys spectabilis*, with its long tail-brush of pure white, is separated from its nearest ally, *D. deserti*, by a group of small dark-tailed forms.

Under the genus *Peromyscus*, comprising the American white-footed mice, the mixture of species and subspecies fairly takes one's breath away. The same is true in less degree of *Microtus* and of numerous other genera throughout the Catalogue.

Sciuropterus volans is given as the name of the European Flying Squirrel and *S. voluncella* as that of the American. This, while in accordance with former usage, is unfortunate since the *Mus volans* of Linnæus, 1766, is the Flying Squirrel of Virginia, as shown by Jordan and Bangs.

Under *Sciurus douglasi* five synonyms are raised to the rank of 'varieties.'

Under *Sciurus aberti*, *S. castanotus* [= *castanonotus*] Baird and *S. durangi* Thomas are given as subspecies. The former is a synonym; the latter a distinct species.

Under *Sciurus arizonensis* are included as subspecies the hardly distinct *huachuca* of Allen

and several widely different species, as *S. colliæi* Richardson, *S. hypopyrrhus* Wagler and others. A curious freak in nomenclature is illustrated by this series, the majority of the 'subspecies' included under *arizonensis* antedating it by many years!

Coming to the Chipmunks, the author abandons his own earlier and, in the reviewer's judgment, excellent division of the group into *Tamias* and *Eutamias* and lumps them all under the former name. In arranging the species and subspecies of this perplexing group it is no wonder he is somewhat mixed, and that the forms are distributed without regard to their affinities. Thus *pricei*, at most a subspecies of *merriami*, is given full specific rank and placed between *townsendi* and *macrorhabdotes*. The latter, instead of ranking as a species, should stand as a synonym of *quadrimaculatus*.

The Spermophiles of the *lateralis* group (subgenus *Callospermophilus* Merriam) are placed in the genus *Tamias*, with which they have no close affinity.

Spermophilus sonoriensis, a subspecies of *tereticaudus*, is placed in a different subgenus! And *tereticaudus* and the closely related *neglectus* are wrongly referred to the subgenus *Ictidomys*.

In many instances Dr. Trouessart adopts the oldest generic name, as *Cœndu* for *Synetheres*; *Ochotona* for *Lagomys*, and so on; but in many cases he fails to do this. Thus,

Cœlogenus F. Cuvier, 1807, is antedated by *Agouti* Lacépède, 1799.

Lagostomus Brookes, 1829, is antedated by *Vizcacia* Schinz, 1824.

Myoxus Schreber, 1782, is antedated by *Glis* Brisson, 1762.

Platycercomys Brandt, 1844, is antedated by *Pygeretmus* Gloger, 1841.

Scirtomys Brandt, 1844, is antedated by *Scarturus* Gloger, 1841.

He uses also many preoccupied names. Among these are:

Arctogale Peters, 1864; replaced by *Arctogalidia* Merriam, 1897.

Echiothrix Gray, 1867; replaced by *Craurothrix* Thomas, 1896.

Hydrolagus Gray, 1867; replaced by *Limnolagus* Mearns, 1897.

Ictis Kaup, 1829; replaced by *Arctogale* Kaup, 1829.

Macrorhinus F. Cuvier, 1826; replaced by *Mirounga* Gray, 1827.

Wagneria Jentink, 1886; replaced by *Bassariscus* Coues, 1887.

The authority for *Tylonyx*, given as a synonym under *Dicrostonyx*, should be Schulze instead of 'Huth.'

Dr. Trouessart is not one of those who regards as sacred the original spelling of generic names. On the contrary, he accepts amended names in preference to the originals and in so doing operates at both ends, changing *Pithecheir* to *Pithecheirus* and *Endecapleura* to *Hendecapleura*!

A number of generic names are given erroneous dates. For instance:

Acomys	dates	from	1838;	not	1840.
Alticola	"	"	1881;	"	1884.
Ctenodactylus	"	"	1830;	"	1828.
Dolichotis	"	"	1819;	"	1822.
Graphiurus	"	"	1838;	"	1829.
Heterocephalus	"	"	1842;	"	1834.
Nyctocleptes	"	"	1832;	"	1835.
Rhombomys	"	"	1841;	"	1843.
Tachyoryctes	"	"	1835;	"	1834.

Under *Echimys* and the amended form *Echinomys* the authorities and dates are badly mixed.

In the case of family names the rule of priority is not always followed. For instance, '*Lagostomidæ* Bonaparte 1837' is antedated by *Chinchillidæ* Bennett 1833; and *Cœndidæ* Trouessart is antedated by *Erethizontidæ* Thomas.

Perhaps the oddest error in the Catalogue is the transposition of the Trinidad Opossum, *Thylamys carri* Allen and Chapman, to the Rodent genus *Tylomys* Peters!

The subfamily heading *Murinæ* is omitted, apparently by accident, and the resulting arrangement as printed puts *Mus* as a subgenus of *Otomys*!

A single new subgenus, *Microlagus*, is named. It is based on *Lepus cinerascens* Allen, a form whose relationship with *L. trowbridgii* is so exceedingly close that it is probably only subspecifically separable, and yet *L. trowbridgii* is placed in a separate subgenus (*Sylvilagus* Gray)!

A curious instance of persistent misspelling is the repeated occurrence of Vernon Bailey's name as Bayley, and of specific names based

thereon as *bayleyi*. Similarly *Reithrodontomys lacei* is spelled *lacyi*.

In dividing the work into parts it is a pity the publishers did not end the second part with the Carnivora instead of including the first 63 pages of the Rodentia. In binding by orders—the most convenient form for most uses—the volume on the Rodentia will have no title-page in front, but has one for the matter posterior to the 63d page, where the 3d fasciculus begins (page 453 of the whole Catalogue).

The reviewer is indebted to Dr. T. S. Palmer for calling his attention to a number of the errors in generic names and dates.

In two instances Trouessart imposes new names on forms distinguished but not named by previous authors, and in both instances modestly but wrongly credits the name to the previous author instead of himself. The cases in point are *Vespertilio gryphus septentrionalis*, attributed to Harrison Allen, and [*Mus*] *sylvaticus* var. *noveboracensis*, attributed to Erxleben, and placed as a synonym of *Peromyscus leucopus*.

The three parts now published comprise the Primates, Chiroptera, Insectivora, Carnivora and Rodentia and contain 760 genera and 4,085 species. Of these, 288 genera and 1,900 species are included in the single order Rodentia.

The Catalogue, in spite of its inherent imperfections, is an extremely useful document and must be at the elbow of every student of mammals.

C. HART MERRIAM.

Guide to the genera and classification of the North American Orthoptera found north of Mexico. By SAMUEL HUBBARD SCUDDER. Cambridge, Mass., Edward W. Wheeler. 1897. Pp. 89. Price, $1.00.

Dr. Scudder began his entomological studies with the Orthoptera, and is still at work elaborating the sub-families, genera and species with reference to a general work on the classification of the order. The little book before us is designed to serve as a Prodomus of the work, which we hope may be completed at a no distant day. As such it will be of great service to the student, since the families, sub-families and genera are tersely and yet fully described. Besides these diagnoses there are elaborate tables for the determination of the families, sub-families and genera; the species not being mentioned.

In addition to the general bibliographical notes, those devoted to the families and the list of the literature are full and presumably exhaustive. The index appears also to be complete. The paper and printing are unexceptional.

It will be seen that the book will be indispensable to the student, as there is nothing like it in our entomological literature. That it has been prepared with thoroughness and care goes without saying. When will the time come when we shall have similar exhaustive manuals of the other orders of insects.

A. S. PACKARD.

Les Ballons-Sondes de MM. Hermite et Besançon et les Ascensions Internationales. Par WILFRID DE FONVIELLE. Bibliothèque des Actualités Scientifiques. Paris, Gauthier-Villars. 1898. 18mo. Pp. 112. Figs. 27.

This brochure by my colleague, the Secretary of the Aëronautical Commission, is timely, since it is the first complete account of an important investigation in Europe. M. de Fonvielle is well fitted to write on the subject, for he is not only a distinguished aëronaut and the author of several books on ballooning, but since their inception he has been an advocate of 'ballons-sondes,' or 'ballons perdus,' as formerly they were derisively named.

When one of these exploring balloons, set free by MM. Hermite and Besançon, in November, 1892, lost its buoyancy and fell to the earth there was obtained for the first time, from its minimum barometer and thermometer, the greatest height and the lowest temperature which had been reached. Fourteen of these small balloons having envelopes, generally of paper, filled with illuminating gas were liberated from Paris and most of them were recovered with their instruments recording the extremes of height and cold. MM. Hermite and Besançon, therefore, were encouraged to continue the exploration of the upper air with larger balloons made of goldbeaters' skin or of special silk, which they called *Aërophiles*. These carried continuously recording barom-

eters and thermometers of Richard's construction, and in March, 1893, records were obtained 49,000 feet above the earth. In 1894 the Berlin Aëronautical Society began similar explorations in connection with manned balloons, and in September the exploring balloon *Cirrus* rose 60,000 feet and recorded photographically a temperature 90° Fahrenheit below zero. In December of the same year Berson, of Berlin, ascended alone 30,000 feet, and, at the highest level ever reached by man, observed a temperature 54° Fahrenheit below zero.

Efforts were now made to secure international cooperation, and the International Meteorological Conference which was held at Paris in September, 1896, furnished the opportunity to M. de Fonvielle. As stated in SCIENCE of January 1, 1897, simultaneous flights of manned and exploring balloons were recommended, and in consequence of the successful experiments with kites lifting self-recording instruments at Blue Hill this method of studying the lower air was advised. A commission was appointed to execute these resolutions, consisting of Messrs. Hergesell (President), of Strassburg; de Fonvielle (Secretary) and Hermite, of Paris; Pomortzeff, of St. Petersburg; Erk, of Munich; Assmann, of Berlin, and Rotch, of Boston. In the first international flight of 'ballons-sondes' on November 14, 1896, balloons were despatched from Paris, Strassburg, Berlin and St. Petersburg, but only the *Aërophile* from Paris reached a great altitude. Three simultaneous flights were made the past year, and the results of these and subsequent ones will certainly elucidate the conditions prevailing through a large extent of the upper air at much greater heights than can be reached by human beings. With these balloons only the barometric pressure and the air temperature are recorded, but after several attempts to obtain samples of the air at great heights this was finally accomplished with the apparatus of Cailletet carried by the *Aërophile.*

The chapter on the theory of a ballon-sonde, and the effect of temperature on the height to which one will rise, presents simply and clearly some important facts and formulæ. In closing this review it may be well to point out a few typographical errors. On pages 16 and 17 the words 'en papier' evidently should be omitted from the heading of the table, since balloons of goldbeaters' skin are included; in the same table the date 1862 should be 1892 and 'température maxima' should be 'température minima;' in the heading of the table on pages 88 and 89 the words 'en soie spéciale' should be omitted for the reason stated above.

It is proposed to hold a meeting of the International Aëronautical Commission next February, to consider plans for a more extended exploration of the atmosphere. As yet exploring balloons have not been employed in the United States, but the development of the kite in this country has proved it to be the best agent for studying the meteorological conditions of the lower ten thousand feet of free air at definitely determined heights. In fact, the records of temperature and humidity obtained with kites 11,086 feet above Blue Hill probably exceed in altitude any balloon observations on this side of the Atlantic, while the proposed use of kites by the Weather Bureau to obtain data for daily synoptic charts of the conditions a mile above the earth's surface may result in improving the weather forecasts.

A. LAWRENCE ROTCH.

Volcanoes of North America: A Reading Lesson for Students of Geography and Geology. By ISRAEL C. RUSSELL, Professor of Geology, University of Michigan; author of 'Lakes of North America,' 'Glaciers of North America,' etc. New York, The Macmillan Co. 1897. 8vo. Pp. xiv + 346. Price, $4.00.

In giving to the world a companion volume to his Lakes, and Glaciers, of North America, Professor Russell has laid under renewed obligation both the geological student and the general reader. He is eminently fitted for the discussion of his present theme. His own travels and explorations have made him familiar with the eruptive phenomena of North America, through a wide range of latitude and longitude, and in manifold variety of type—from the Mesozoic trap sheets of New Jersey, to the majestic snow-clad cone of Rainier; from the craters of the Mono valley, to the widespread stratum of volcanic dust in the valley of the Yukon. To the knowledge gained by personal

observation he has added an extensive and critical acquaintance with the varied literature of the subject.

The book opens with a general discussion of the characteristics of volcanoes, in which the various types of eruption are illustrated by the classical examples of Stromboli, Vesuvius, Krakatoa, the Hawaiian volcanoes and the colossal lava sheets of the Deccan and the Columbia valley. A description of the gaseous, liquid and solid ejecta of volcanoes is followed by a discussion of the form and structure of volcanic cones and necks. Next are described the characteristic types of subterranean intrusions —dikes, sheets, plugs, laccolites and subtuberant mountains. The opening chapter closes with a brief discussion of the characteristics of igneous rocks. A brief and popular petrological section is by no means an easy thing to write. The requirement of perfect accuracy in brief and non-technical language is somewhat like the pious old woman's order on her bookseller for a very small Bible with very coarse print. The following statements are inaccurate and confusing: "If fused slag is cooled quickly, crystals are not developed, but the mass has a glassy or stony structure" (p. 68); "if solidification takes place at this stage [after formation of minute crystals floating in the still fused material], the ground mass becomes a glass or felsite" (p. 112); "if the cooling is rapid, a crystalline glass is produced" (p. 114). The application of the name basalt to the coarsely crystalline rock of the Palisades involves an extension of the meaning of the word unwarrantable even in a brief and popular discussion. The statement that trachyte is normally dark colored is certainly misleading. With Dana and others, Professor Russell holds that some granites are truly metamorphic rocks. The tendency at the present time is to derive gneisses from granites rather than granites from gneisses; but we believe there is truth in both views.

The main part of the book, as implied in the title, is occupied by the description of the active and recently extinct volcanoes of North America; and the reader cannot fail to be interested in the great variety of volcanic phenomena so clearly described in its attractive pages. The eruption of Coseguina in 1835 almost rivals in tremendous explosiveness that of Krakatoa in 1883. In Mount Taylor and its companions are seen beautiful examples of volcanic necks. The volcanoes of the Mono valley include a remarkable variety of volcanic phenomena; and the pages devoted to their description, bright with the vividness of personal observation, are among the most fascinating in the book. In Crater Lake we have a magnificent example of a caldera formed by the ingulfing of a volcanic cone. The reader will readily sympathize with the author's enthusiasm over the majestic beauty of the snowy cones that dominate the Cascade Range. In the Columbia lava sheet we have the result of colossal fissure eruptions rivaled only by those of the Deccan. The Spanish Peaks are beautiful examples of volcanoes dissected by erosion. In Shishaldin we see a volcanic cone, the symmetry of whose graceful, slightly concave lines rivals the beauty of Fusiyama. In Bogosloff we have apparently a shapeless mass formed by the sudden chilling of highly viscid lava erupted beneath the sea.

From the description of the volcanic phenomena shown in North America the author returns to the discussion of volcanoes in general. The reader who has become familiar with such widely varied details is in position to appreciate the inductions which may be drawn from them in regard to the mechanism of volcanic eruption. Professor Russell adopts the view that the interior of the earth is solid, but potentially liquid at no great depth below the surface—a view which seems to harmonize the teachings of geology with those of physics. In common with Reyer, the author attributes the relief of pressure, which is the condition of local liquefaction, and consequently of eruption, to the formation of fissures. We are inclined to believe that the principal cause of such relief of pressure and consequent liquefaction is found in crustal elevation, as suggested by Archibald Geikie.* Professor Russell rightly connects igneous intrusions with volcanic eruptions, as different phases of the same process. A true and comprehensive theory of vulcanism must include all phases of eruption and intrusion.

* Text-book of Geology, 3d edition, p. 268.

Incidentally, we remark that it may well be questioned whether the theory of protuberant mountains, so beautifully illustrated in the Sundance Hills, is not unduly stretched in attempting to make it cover the Front Range of the Rockies in Colorado and Wyoming. Finding the essential condition of eruption in liquefaction by means of relief of pressure, Professor Russell makes the rôle of steam merely incidental. The action of steam is conspicuous enough in volcanic eruptions of the explosive type, but it cannot account for the phenomena of great fissure eruptions ; and the two extreme types of eruption are so connected by fine gradations that the general cause must be identical throughout the whole series. In criticising the special form of the steam theory proposed by Shaler, the author justly protests against the enormous thickness of sediments postulated by that theory. Professor Russell holds the steam contained in lavas to be exclusively of superficial origin. This is undoubtedly true of a part of it, and probably of much the larger part. But the fluid cavities of plutonic rocks are proof of the existence of water vapor in magmas at great depth, and it appears probable that somewhat of this vapor may have been occluded in the originally molten mass of the globe. Professor Russell holds that volcanic activity increased through geologic time until the Tertiary, and that it is now declining. This conclusion seems to us not supported by adequate evidence. According to modern views of the mode of solidification of the globe, the reaction of its heated interior upon its surface could not have been very different in Cambrian time from what it is now. The apparent rarity and insignificance of volcanic phenomena in the earlier geological periods may well be explained as due to the destruction of the evidence by erosion and metamorphism, or its concealment beneath masses of superincumbent strata.

The closing chapter, on the life history of a volcanic mountain, is an exquisite piece of scientific description, in which picturesque imagination gives vividness without detracting from scientific accuracy. One incidental point, however, we should be disposed to criticise. We would not, indeed, contradict the statement that it is *possible* that the aborigines, so artistically introduced to add a human interest to the pictures of natural scenery, were living in Tertiary time ; but we do, nevertheless, consider such a supposition extremely improbable.

The book, so delightful and instructive, would have been made still better by more careful proof-reading. Several proper names are misspelled. We read *Atria del Cavallo*, instead of Atrio ; *Mazana*, instead of Mazama ; *Roichthofer*, instead of Richthofen ; *Johnson-Lewis*, instead of Johnston-Lavis. In the note on page 74, in which the last name is thus misspelled, the reference to the *American Journal of Science* should be to Vol. 36. Typographical errors have rendered a few sentences ungrammatical or nearly unintelligible. The printers have also metamorphosed the young insects of Lake Mono into *lavæ*. The book is thoroughly attractive in its mechanical execution. Many of the pictures (mostly reproductions of photographs) are very beautiful.

WM. NORTH RICE.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY, DECEMBER 20, 1897.

THE first paper of the evening was by Mr. Arthur Hollick, entitled 'Recent Explorations for Prehistoric Implements in the Trenton Gravels, Trenton, N. J.' Dr. Hollick gave in his paper a summary of the present understanding of the artifacts found in the Trenton gravels, a more complete statement of which has already been published in SCIENCE for November 5, 1897. The second paper of the evening was by Professor J. F. Kemp, entitled 'Some Eruptive Rocks from the Black Hills.' Professor Kemp summarized the geological features and history of the Black Hills, and gave a bibliography of the works concerning these deposits. He then mentioned the occurrence of some Leucite-bearing rocks, in the northern part of the hills, similar in character to those which occur in but few other places in this country, as in Wyoming, Montana, Lower California and New Jersey, near the Franklin Furnace.

RICHARD E. DODGE,
Secretary.

SCIENCE

FRIDAY, JANUARY 14, 1898.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*SOME OF THE FUNCTIONS AND FEATURES OF A BIOLOGICAL STATION.**

I HAVE a few considerations to offer on a subject not quite new, but perhaps not without some interest, to a Society of Naturalists. The subject may be stated in the form of a question: What are some of the more essential functions and features to be represented in a biological station? This question is one that may fairly claim the attention of a society organized for 'the discussion of methods of investigation and instruction, and other topics of interest to investigators and teachers of Natural History; and for the adoption of such measures as shall tend to the advancement and diffusion of the knowledge of Natural History.'

I know of no other organization in this country in which the different sides of biology are more fully and widely represented, and no other in which the discussion of such a question as I have stated has been more explicitly invited.

The question before us, as you perceive, is one of ideals, something which we can construct without the aid of an endowment, and probably without any permanent loss of protoplasm. And yet, what I have in mind is not wholly imaginary, for it has

*Address of the President of the Society of American Naturalists prepared for the Ithaca meeting, 1897, but not delivered, owing to the unavoidable absence of the writer.

some basis in experience and in acquaintance with some of the best models.

Let us, first of all, try to get at some general principle which may serve to guide our judgment of ideals, and by the aid of which we may be able to formulate an answer to the question proposed.

As all will allow, ideals are absolutely indispensable to progress, and always safe provided they are kept growing. Like all biological things, live ideals originate by germination, and their growth is subject to no limit except in mental petrifaction. Growth and adaptability are as natural and necessary to them as to living organisms. Here we have, then, an unfailing test for the soundness or relative merit of ideals. Seeds may be kept for years without sensible change or loss of power to germinate. But it is because they are kept, not planted and cultivated. Once planted, they must grow or rot. So it is with ideals. The unchanged ideal that we sometimes hear boasted of is at best but a dormant germ, not a plant with roots and branches in functional activity. If an ideal stands for anything which is growing and developing, then it must also grow, or be supplanted by one that will grow. It is easy, of course, to conceive of ideals a hundred years or more ahead of possible realization; but such ideals could have no vital connection with present needs, and long before the time of possible realization they would cease to be the best, if the best conceivable at the start.

We are here, then, concerned only with ideals rooted in experience and continually expanding above and in advance of experience. The moment growth ceases, that moment the work of the ideal is done. Something fails at the roots and you have waste mental timber to be cleared away as soon as possible to make room for the new seed.

Let us here take warning of one danger to which we are all liable—the danger of adopting ideals and adhering to them as finalities, forgetting that progress in the model is not only possible, but essential to progress in achievement. The danger is all the greater in the case of ideals lying outside our special field of work, which we are unable to test and improve by our own efforts. The head may thus become stored with a lot of fixed mental furniture, and the possessor become the victim of an illusion, from the charms of which it is difficult to disenchant him. He falls into admiration of his furniture, taking most pride in its unchangeableness. It was, perhaps, the best to be found in the market at the time of installment, and he finds pleasure in the conceit that what *was* the best is and must remain the best. He sees new developments in the market, but his pride and inertia content him with the old. The illusion now takes full possession of him, and every departure from his own ideals seems like abandonment of the higher for the lower standard of excellence. His conceit grows instead of his ideals, and every annual ring added to its thickness renders it the more impervious.

Can any one say he has never met this illusion? Then a warning may have more pertinency than I should have ventured to claim for it.

To conclude these introductory remarks let me again emphasize the all-important qualification of the sound ideal and name the prime condition of its usefulness. The qualification is vitality and the capacity for unlimited growth and development. The condition is absolute freedom for growth in all directions compatible with the symmetrical development of the science as a whole. Please remember that the question of means does not now concern us. We must first get at principles, leaving details of execution to be worked out afterwards in harmony therewith. No one can foresee what means may

be found, and it would be a waste of time to try to decide what should be done under this, that or the other set of conditions. If we know our ideal we know the direction of effort, and through the effort the means are eventually found.

It will help us in the formulation of our ideal if we glance for a moment at the ideals that have found most favor. The best models of marine laboratories ten years ago all agreed in making research the exclusive aim and in limiting the work to marine forms. In most cases the work was still further limited, embracing only marine zoology, and often only a small portion of that field. The idea of representing all branches of even marine biology was seriously entertained nowhere except at Naples. Remembering that marine laboratories were first introduced only about a quarter of a century ago, we are not surprised at these limitations. Even the narrowest limitations were extensions beyond what had been done before. The Naples Station itself began as a zoological station, and still bears the name *Stazione Zoologica*. But the earlier ideal was not long in expanding so as to include both physiology and botany. Will its growth stop there? I don't believe it will, but that remains to be seen.

Our own seaside schools, introduced by Louis Agassiz at Penikese and continued by Professor Hyatt at Annisquam, combined instruction with research, and this plan was adopted at Woods Holl in 1888. Instruction, however, was accepted more as a necessity than as a feature desirable in itself. The older ideal of research alone was still held to be the highest, and by many investigation was regarded as the only legitimate function of a marine laboratory. Poverty compelled us to go beyond that ideal and carry two functions instead of one. The result is that some of us have developed an ideal of still wider scope, while others stand as they began by their first choice.

We have, then, two distinct types of ideals, the one including, the other excluding instruction. One is preferred for being limited to investigation; the other is claimed to be both broader and higher for just the contrary reason, that it is not limited to investigation. At first sight, it might seem that we had exact contraries, but that is really not the case, for one type actually includes the other, and differs from it only by the more which it contains. The difference is, nevertheless, an important one, and as it divides opinion we must examine it.

To my mind, nothing but experience can settle such a question; but if reason and experience coincide, so much the better, so we may consider it from both points of view. On the basis of ten years' experience, and a previous intimate acquaintance with both types, I do not hesitate to say that I am fully converted to the type which links instruction with investigation; and I believe that many, if not most, of my colleagues in the work at Woods Holl, would now concur with me in the opinion that we could not wisely exclude instruction, even if made free to do so by an ample endowment. Some of you will probably feel that such a conclusion implies a step backward rather than forward. On which side is the illusion? Is it with those who have accepted their ideal second-hand and held to it unchanged from the time of its adoption, or with those who have been compelled to develop their own ideal from all that they could learn by actual experiment and study? Which is the broader ideal, and with which are the possibilities for progressive growth least limited?

In what consists the argument for limitation to research? I have yet to learn of a single important advantage which is necessarily dependent upon this limitation. Is instruction a burden to the investigator which interferes with his work? That objection is frequently raised, and it is about

the only one that we need stop to consider here. That instruction interferes with investigation when it is so arranged as to absorb all, or the larger share, of one's time, no one will deny. But is it not easy to so divide the time that the investigator will find rest and improvement from the instruction he gives? Certainly it is possible, as we have fully demonstrated at Woods Holl, and that too with only the most limited means. With a laboratory open throughout the year, the investigators connected with it would scarcely feel a few weeks' instruction as an impediment. Not only have we shown that such an accommodation or adjustment of the functions is possible and tolerable even in our vacations, but we have also learned that there are some important advantages growing out of it which are impossible under limitation to research. To my mind these advantages far outweigh any and all objections.

The advantages I have in mind are not those of means for running the laboratory, which could be supplied by an endowment, but those which add directly to the progress of the investigator and to the advancement of his work. If important advantages exist in connection with instruction even where there is no endowment, which are not available even with an endowment, where instruction is excluded, we can readily make our choice of types.

I suppose no investigator, not even the most confirmed claustrophil, would deny that instruction compels thinking and improves ability to express ideas as well as to describe facts. So does writing, so does investigation itself. True, and if that is to their credit, it must be the same to instruction. But wherein is the advantage with instruction? Every teaching investigator can answer that; and the answer will be, that power of exposition can be acquired and perfected by class-work and lectures to an extent otherwise unattainable. In this we need no better example than Huxley. If rare powers of exposition are sometimes gained without teaching, as in the case of Darwin, that in no way weakens the position here taken, which is that teaching is the most effective method, not the only one, yet an essential one to the highest attainment.

One thing more on this point. Why do we place so high a value on investigation? Because it is the only way of advancing knowledge, and because it affords a most attractive field for the exercise of the mind. But if knowledge needs advancement, so does the investigator, and whatever contributes to the increase and improvement of his powers makes him the better investigator, and thus indirectly raises the quality and augments the quantity of his researches. Herein instruction plays a very important part, as becomes evident when we remember that with increase and specialization in science the investigator himself becomes more and more dependent upon the instruction which he draws not only from books and journals, but also directly from his colleagues and his pupils. Indeed, he may learn in this way much quicker and more thoroughly than by reading, and often a long time in advance of publication. That is an immense advantage realized in a variety of ways, as in lectures giving the more important results of work before publication; in seminar where the results of individual investigators are brought forward and discussed, while the work is still in progress; in journal clubs devoted to reviews and discussions; in direct intercourse with pupils, seeing with their eyes and working with their hands; in daily intercourse of thought and comparison of observations with fellow-workers, etc. Indeed, it may be truly said that no one stands in such close and pressing need of continual instruction as the investigator. No one else absorbs it more eagerly and

copiously, and no one else can convert it so directly into the results of research.

Another advantage supplied by instruction must be mentioned here, for in it I see opportunities for development of far-reaching importance to research. It is lamentable to see so much energy available for research lost or ineffective for lack of proper directive coördination. The avalanche of modern biological literature consists too largely of scrappy, fragmentary, disconnected products of a multitude of investigators, all working as so many independent individuals, each snatching whatever and wherever he can, and then dumping his heterogeneous contributions into the common hodge-podge. How are we ever to extricate ourselves from such appalling confusion? The ambition to be prolific rather than sound is a peril against which we seem to have no protection at present. And yet, if I mistake not, there is a growing sentiment against such traffic in science, which will eventually make it plain that ambition in that direction spends itself in vain. A dozen or more dumps a year, with as many or more retractions, corrections and supplements, is only a modest-sized ambition. Conclusions are palmed upon the unsuspecting reader, and then, without compunction or apology, reversed from day to day or from month to month, or, worse still, in an appendix subjoined, so that it may be seen how little it costs to be prolific when one day's work cancels another.

It behooves us to find effective remedies as rapidly as possible. The correction would be complete if each worker could bridle his lust for notoriety and take the lesson of Darwin's industry and reservation into his laboratory and study. The outlook for such a millennial dispensation is not very hopeful, and our resources are few and very inadequate, but all the more deserving of attention. The great need is *long-continued*, *concentrated* and *coördinated* work. In a laboratory which draws beginners in investigation in considerable numbers it is possible to assign problems in such a way that the participants may work in coördinate groups, and the problems be carried on from year to year, and from worker to worker, each performing his mite in conjunction and relation with the others of his group. In this way energy would be utilized to the greatest advantage to science as well as to the individual. Even under the very imperfect conditions represented at Woods Holl, I have found it possible to put this idea into practice to some extent, and I have great faith in its efficacy. Herein we see another possibility of development realizable only through instruction.

But it is as important for independent investigators as for beginners to cultivate organic unity in their work. How shall the investigator hope to keep in touch with the multiplying specialities of his science? Here, again, I maintain that instruction is an indispensable means. Fill a laboratory with investigators and, if no instruction is provided, many of the more important avenues of acquisition will be closed and the opportunities for coördination of work will be of little or no avail. Investigators might work for months in adjoining rooms and never learn anything about each other's work, as every one knows who has worked in such a laboratory. How different in a laboratory, where instruction is so arranged as, without over-taxing any one, to bring the workers into active and mutually helpful relations, and enable them to draw from one another the best that each can give! Instruction in the various forms before indicated supplies just the conditions most favorable to interchange of thought and suggestion. It is just this feature of our work at Woods Holl to which we are most indebted for whatever success we have had.

I am aware that other points might be raised; but it is far from my purpose to run down all possible objections. It is enough to have indicated the grounds of my choice of types. It now remains to briefly sketch the general character and to emphasize some of the leading features to be represented in a biological station.

The first requisite is capacity for growth in all directions consistent with the symmetrical development of biology as a whole. The second requisite is the union of the two functions, research and instruction, in such relations as will best hold the work and the workers in the natural coördination essential to scientific progress and to individual development. It is on this basis that I would construct the ideal and test every practical issue.

A scheme that excludes all limitations except such as nature prescribes is just broad enough to take in the science, and that does not strike me as at all extravagant or even as exceeding by a hair's breadth the essentials. Whoever feels it an advantage to be fettered by self-imposed limitations will part company with us here. If any one is troubled with the question: Of what use is an ideal too large to be realized? I will answer at once. It is the merit of this ideal that it can be realized just as every sound ideal can be realized, only by gradual growth. An ideal that could be realized all at once would exclude growth and leave nothing to be done but to work on in grooves. That is precisely the danger we are seeking to avoid.

The two fundamental requisites which I have just defined scarcely need any amplification. Their implications, however, are far-reaching, and I may, therefore, point out a little more explicitly what is involved. I have made use of the term '*biological station*' in preference to those in more common use, for the reason that my ideal rejects every artificial limitation that might check growth or force a one-sided development. I have in mind, then, not a station devoted exclusively to zoology, or exclusively to botany, or exclusively to physiology; not a station limited to the study of marine plants and animals; not a lacustral station dealing only with land and fresh-water faunas and floras; not a station limited to experimental work, but a genuine biological station, embracing all these important divisions, absolutely free of every artificial restriction.

Now, that is a scheme that can grow just as fast as biology grows, and I am of the opinion that nothing short of it could ever adequately represent a national center of instruction and research in biology. Vast as the scheme is, at least in its possibilities, it is a true germ, all the principal parts of which could be realized in respectable beginnings in a very few years and at no enormous expense. With scarcely anything beyond our hands to work with, we have already succeeded in getting zoology and botany well started at Woods Holl, and physiology is ready to follow.

If, now, experimental biology could be started, even in a modest way, it would add immensely to the general attractions of our work; for it would open a field which is comparatively new and of rapidly growing importance. There are so many things now called 'experimental' that I must explain what I have in mind sufficiently to make the general purpose intelligible.

It is not the experimental embryology redundantly described as 'developmental mechanics' which is now in vogue; not laboratory physiology, even in its wider application to animals; not egg-shaking, heteromorphism, heliotropism and the like —not any of these things, but experimental natural history, or biology, in its more general and comprehensive sense. It is not the natural history of the tourist, or the museum collector, or the systematist, but

the modern natural history, for which Darwin laid the foundation, and which Semper, Romanes, Galton, Weismann, Varigny, Lloyd Morgan and others have advocated and practiced to the extent of the meager means at their command. The plan which I should propose, however, has not, so far as I am aware, been definitely formulated by any one, although some of its features were indicated several years ago, when I proposed such a station in connection with the University of Chicago. The essentials of the plan were sketched as follows:

"Experimental biology represents not only an extension of physiological inquiry into all provinces of life, but also the application of its methods to morphological problems—in short, it covers the whole field in which physiology and morphology can work best hand in hand. * * *

"A lake biological station equipped for experimental work would mark a new departure for which science is now ripe. Such a station has nowhere been provided, but its need has been felt and acknowledged by the foremost biologists of to-day. There are no problems in the whole range of biology of higher scientific interest or deeper practical import to humanity than those which center in variation and heredity. For the solution of these problems, and a thousand others that turn upon them, facilities for *long-continued experimental study, under conditions that admit of perfect control, must be provided.* Such facilities imply, first of all, material for study, and that nature here supplies in rich abundance. Then a convenient observatory, with a scientific staff, is required. In addition, and this is all-important, there should be not only aquaria and plenty of running water, but also a number of ponds with a continuous supply of water, so arranged that the forms under observation could be bred and reared in isolation when necessary. Finally, there should be room for keeping land animals and plants under favorable conditions for cultivation and study. A station with such facilities as have been briefly indicated would furnish ideal conditions for the prosecution of research in nearly every department of biology, and especially in embryology and physiology." *

If such a station could be developed in immediate connection with the plant already under way at Woods Holl we might begin to realize what a biological station stands for.

We need to get more deeply saturated with the meaning of the word 'biological,' and to keep renewing our faith in it as a governing conception. Our centrifugal specialties have no justification except in the *ensemble*, and each one of them is prolific in grotesque absurdities, for which there is no correction in disconnection with the organic whole. But why talk of an organic whole which no man can grasp or make any pretension to mastering? Precisely that makes it necessary to talk and act as if we knew the fact, and as if our inability had not rendered us insensible to our need. Physiology is meaningless without morphology, and morphology equally so without physiology. Both find their meaning in biology, and in nothing less. What an absurdity was human anatomy without comparative anatomy, and comparative anatomy was only a much bigger absurdity until the general connection of things began to dawn in the conceptions of biology. Just think of a physiologist seriously proclaiming to the world that instinct reduces itself in the last analysis to heliotropism, stereotropism and the like. The whole course of evolution drops out of sight altogether, and things are explained as if the organic world were a chemical creation only a few hours old. The absurdity is no greater than for a geologist to

* Program of Courses in Biology, Chicago, 1892.

try to explain the earth without reference to its past history.

Think of a young morphologist, with all the advantages of the Naples Station at hand—yes, within the walls of that grand station—loudly sneering at Darwinism, and spending his wit in derisive caricatures of general truths beyond the horizon of his special work and thought. And shall we forget the physiologist whose philosopher's stone is the search for his ancestry among the Arachnids? Or the anatomist who reverses his telescope to discover that his science begins and ends in terminology? And could we, much as we might yearn for such a benediction, forget the omnipresent and omniscient systematist whose creed is summed up in priority?

The catholicon for crankiness has not yet been found, but in science there is but one cure where cure is possible; it is exposure to the full and direct rays of the system as a whole. The application to the subject in hand is patent. The one great charm of a biological station must be the fullness with which it represents the biological system. Its power and efficacy diminish in geometrical ratio with every source of light excluded.

My plea, then, is for a biological station, and I believe that experimental biology would be the most important element in such a station. It is now possible to procure a favorable site, with land and fresh-water privileges, in close proximity with the Marine Biological Laboratory; and with a moderate foundation to start with, the work could begin at any moment.

The project is certainly one of preëminent importance, and for a successful undertaking of that magnitude we need the coöperation of American naturalists. I bring the suggestion before you in the hope that it will enlist your interest and support.

C. O. Whitman.

RECENT PROGRESS IN AGRICULTURAL CHEMISTRY.

II.

The methods of the chemical changes produced in the growth of plants have recently received an admirable study at the hands of Green. (Journal of the Royal Agricultural Society of England, Vol. 6, third series, part 4, pp. 635 *et seq.*) The chief object of Green's study is the reserve food materials of plants, but in conducting these investigations he studies carefully the chemical action on which the plant metabolism is based. The apparatus of the plant, which is active in vegetable metabolism, was studied microscopically and fully illustrated by drawings.

The source of chemical activity in plants is confined to certain small bodies which are imbedded in the layer of protoplasm or living substance which lines the cells of the plants. These small bodies are called chloroplastids or chlorophyll corpuscles, and it is to them that we must look for the actual constructive activity. These are comprised essentially of small masses of protoplasm which have a loose or spongy arrangement of particles forming a complicated mesh work. In the meshes of this spongy mass the green color known as chlorophyll is found. It exists principally in solution. The work which is done by the chloroplastid is very complex, but it is possible to distinguish to a considerable extent between the part played by the green coloring matter itself and that which is discharged by its protoplasmic framework. On account of the character of this material the air has ready access to the interior tissues of the leaf. It enters at the stomata and fills the intercellular spaces. This air contains the small quantity of carbon dioxid which is the fundamental material of plant metabolism. The water which is taken in by the rootlets of the plant contains various mineral and nitrogenous matters in solu-

tion and is conducted directly to the leaf by means of the circulation of the plant itself. This water, the mineral and nitrogenous matters which it contains in solution, and the carbon dioxid which enters from the air, are the raw materials which by plant metabolism are changed into the tissues of the living vegetable.

The source of energy, by means of which this wonderful chemical synthesis is produced, is the heat and light coming from the sun. Green is of the opinion that formaldehyd is one of the first products of the condensation of the carbon dioxid, but as formaldehyd is essentially a poison and a preservative it is not probable that its existence is more than momentary. It may be that formaldehyd is one of the transitory products of vegetable metabolism, but it cannot be regarded as being produced in any considerable quantities or existing for any length of time.

The final and possibly the direct product of the condensation is some form of sugar. The production of these reserve stores of food, viz., carbohydrates, proteids and fats in quantities largely in excess of those necessary for the growth of the plant itself are fully discussed, and the very latest views concerning the methods of storage and subsequent use of these materials clearly pointed out.

Investigations of marked interest have lately been conducted on the properties and functions of humus. Hilgard has shown that the nitrogen content of humus found in the soil of the California Agricultural Experiment Station is as much as 18 per cent. in the virgin state. The content of nitrogen in the humus by after years' culture was reduced from 18 to 3 per cent. In the meanwhile, however, the total percentage of humus in the soil had slightly increased.

The obvious conclusion to be drawn from these researches is that the fertility of a soil, in respect of its humus, does not depend so much on the actual percentage of humus itself as upon the nitrogen content therein. When a plant, therefore, gives evidence of nitrogen hunger it is not always due to a deficiency of humus, but probably rather to the diminution of the nitrogen content of the humus.

A more striking example came to Hilgard's attention in a soil from Hawaii, which, after three years of cultivation, gave evidence of marked deficiency in the nitrogen ration of the plant. The virgin soil showed a content of 10 per cent. of humus, which is far above the average of even fertile soils. On analysis, however, it was found that the nitrogen content of the humus had been reduced to 1.7 per cent. It is concluded from the observations of the deportment of crops on soils of this kind that wherever the nitrogen in the humus of the soil falls below 2.5 per cent. of the total weight of the humus the crop will show evidences of nitrogen hunger.

Snyder has shown that in sterilized sand oats will not grow when fed with humus in which no nitrifying ferments are present. If, however, the nitrifying ferments be added in the form of leachings from an arable soil the oats will grow and develop in the usual manner.

Snyder has also shown, as a result of his investigations, that humus acts not only in supplying the elements of fertility, but also in combining with mineral matters, especially potash, producing in the soil potassium humates and rendering the potash thus more easily assimilable. In other words, the humus acts in a favorable manner by converting the inert plant food of the soil into a form in which it can be absorbed. The experiments in sterilized pots show that the humates of potassium, magnesium and iron and the double humates of phosphorus and sulfur can be utilized directly as plant food, provided nitrifying

organisms be present. (Bulletin Minn. Agr. Exp. Sta. No. 41.)

The remarkable property of vegetable soils, consisting largely of humus, in increasing the nitrogen of a cereal crop, has been noticed in the experiments of the Chemical Division of the Department of Agriculture at Washington. In three successive years roots growing in a vegetable soil from Florida have shown an increased percentage of nitrogen as compared with roots grown in the same conditions in typical arable soils. The increase in nitrogen content has, in some instances, been as high as 30 per cent. in a whole crop.

An examination of the character of the nitrogen-content of the soil shows that this increase is largely in the form of amid nitrogen.

I have frequently noticed in Florida the mechanical absorption of humus by a plant in the case of sugar cane grown upon the peaty soils. The juices of these canes often have a distinct brown color which is characteristic of water which has passed through a soil of this nature. The sugar which is made from these canes does not have the bright crystalline appearance of ordinary sugars made from cane, but has a brownish tint difficult to remove even when the sugars are of a high degree of purity.

There is no doubt whatever of the fact that the liquid absorbed by the plant rootlets carries mechanically in solution particles of humus to all parts of the plant.

It thus appears that humus has a more direct use as a plant food than has been supposed by those who adopted *in toto* the mineral theory of Liebig, and this is shown by its nitrogen content, as studied by Hilgard; by the action of humates in supporting plant life, as investigated by Snyder, and by the actual increase in the content of nitrogen in plants, grown upon peaty soils, noticed in our own experiments.

It has been generally supposed by agricultural investigators that the acidity of a soil injurious to crops is found only in peaty or marshy soils. This idea has been found to be incorrect by the investigations of Wheeler, which have shown that many of the soils of Rhode Island, not subjected to overflow nor in any sense marshy or peaty, are so acid as to prevent the proper growth of crops. These soils are not particularly deficient in plant food, but ordinary crops fail to flourish when planted therein. The simple application of lime, in sufficient quantities to correct the acidity of the soil, is enough to convert those almost barren fields into highly productive areas.

The difficulty of estimating properly the acidity of the soil has been the chief obstacle in the way of a more thorough investigation of this subject. The acid reaction of peaty soils, as well as all others, is due, as a rule, to the presence of free humic acid or of acid humates. The exhaustion of the soil in any way for the determination of the moisture in the filtrate obtained gives imperfect and unsatisfactory results. In the titration of the extracts obtained the processes which are used in the saturation may act upon the humus bodies, decomposing them and producing fresh portions of humic acid and thus increasing the apparent acidity. This goes on with especial vigor in the presence of free oxygen.

To avoid this difficulty, Tacke has devised a method of determining the acidity in an environment free of oxygen. The essential principle of the apparatus is in having a flask, from which the air can be removed by any convenient method, preferably by a stream of hydrogen, so arranged that when the oxygen is entirely eliminated precipitated carbonate of lime, suspended in water free of oxygen, can be introduced and brought in contact with the finely divided peat or soil. In this way the decomposition of the finely divided calcium carbonate can only be effected by the

free acid or acid humates already formed, and no humus in the absence of oxygen can be converted into an acid and thus increase the amount of carbon dioxid evolved. The quantity of carbon dioxid evolved is estimated by the usual methods and thus an exact measure of the total acidity is secured. (Chemiker-Zeitung, March, 1897, p. 174.)

The claim has been repeatedly made that soda can replace potash to a certain extent in plant growth. The physical and chemical similarity between these two substances is so great that it would not be surprising to find also a physiological resemblance. Wagner, in fact, claims to have demonstrated that a slightly less quantity of potash is needed for plant growth, provided abundant supplies of sodium are present. These deductions of Wagner, however, have not been confirmed by other experimenters. When good effects have followed the application of soda it has been demonstrated that it is due to other causes than the replacement of potash in plant tissues. Soda in certain circumstances may act happily on inert plant food in the soil and render it assimilable. In this respect it doubtless can assist greatly in plant growth. In respect of the mineral food of plants it may be said that it appears to be of two kinds: First, the minerals which are essential, such as phosphoric acid, potash, lime and magnesia. A certain quantity of these mineral substances seem to be necessary for the production of a given quantity of dry plant tissue. But plants have also a general appetite for mineral substances, eating freely in addition to the quantity necessary to their proper nutrition. The exact physiological function of this excess of mineral food cannot be determined, and it is probable that it is largely accidental. Nevertheless, recent investigations have shown that plants thrive best where mineral food, even when non-essential, is liberally supplied, and in these cases soda doubtless plays its part, together with other non-essential matter.

In the light of our present knowledge, however, it must be denied that soda can, in any essential way, replace potash in plant growth.

In a recent re-study of the proteids of the maize kernel, Osborne has brought practically to a close his interesting and valuable contributions to our knowledge of the proteid matters existing in many common cereals. In a sample of yellow maize meal he finds 3.15 per cent. of a proteid soluble in a 0.2 per cent. solution of potash. This proteid contains 15.82 per cent. of nitrogen. The quantity of zein is 5 per cent., containing 16.32 per cent. of nitrogen. These two proteids comprise almost the whole of the proteid matter in the maize. In addition to these, there are minute quantities of edestin containing 18.10 per cent. of nitrogen; a globulin, containing 15.25 per cent. of nitrogen, and a proteose, containing 17 per cent. of nitrogen. Maysin exists to the extent of one-quarter of one per cent. and contains 16.70 per cent. of nitrogen.

As a result of all the determinations, it appears that the mean percentage of nitrogen in the proteids of maize is 16.057.

The proper factor for the multiplication of proteid nitrogen to determine the total weight of proteids in maize is, therefore, 6.22. This is so near the common factor of 6.25 as to make practically little difference in the statement of results. The factors by which nitrogen should be multiplied in order to obtain the weights of proteids in common cereals are: for wheat, 5.70; rye, 5.62; maize, 6.22; oats, 6.06, and barley, 5.82. This revision of the factors for determining the total amount of proteid matter is not only important as regards this matter itself, but also affects the number for the determination of the carbohy-

drates, which is usually made by difference. Agricultural analysts hereafter should use the factors mentioned instead of the common factor 6.25, which has been so long employed.

The use of the basic bessemer process for the manufacture of steel from phosphoriferous pig iron has not yet been fully established in this country. The agricultural importance of this branch of manufacture is found in the production of basic phosphatic slags. In Europe this industry has grown to an enormous magnitude, and it is estimated that at the present time the rate of production in that country is a million and a-half tons of basic slag annually. All this material has found a ready market in the fertilizer trade, and the result has been a corresponding depression in the prices of superphosphates.

The methods of valuing the fertilizing properties of basic slag have lately been worked out very thoroughly in different localities in this and other countries. The difficulties attending the solution of the phosphoric acid in acid ammonium citrate are found chiefly in the varying quantities of uncombined lime which the slags contain. This subject was introduced at the last meeting of the Association of Official Agricultural Chemists, but the discussion was only of a formal nature, it having been relegated to the next meeting.

In addition to the chemical methods of analysis the separation of the slags into silts of different magnitudes will probably prove of use. This cannot be accomplished by subsidence in water, on account of the solvent action of the water on the quicklime present. The substitution of alcohol of appropriate strength, however, obviates this difficulty and renders the mechanical separation of the slags easy of accomplishment.

In this country basic slags have been manufactured only at Pottstown, Pa., and at Troy, N. Y. I visited a large factory at Troy last winter, which was then in full action, but I believe it has been shut down on account of the low price of steel billets. It is believed, however, that a vast quantity of phosphatic iron ores will soon be brought into the market in this country and that the by-product, basic slags, will find a ready agricultural use.

Experience has shown that these slags act happily on sandy soils, and, in fact, in most cases can replace the acid phosphates where phosphoric acid is indicated in the application of fertilizers. The association of agriculture and manufacture in this respect cannot fail to be of value, and it may soon be possible to offer to the farmer available phosphoric acid, in the form of basic slags, at a lower price than can be profitably asked for acid phosphates.

In terminating this brief review of recent progress in agricultural chemistry, I am as fully aware as any of you of the imperfect nature of the *résumé* which has been given. I was not asked, however, until a short time ago to prepare this paper, and have been compelled to gather the information by piecemeal and in the intervals of other pressing duties. I am certain that in my hurry I have omitted many points of progress made by our own investigators which ought to have been incorporated in the paper. I only hope that the one who is next called upon to present a *résumé* of this progress may be given a longer time in which to prepare for his duties.

H. W. WILEY.

DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

THE MONTREAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA.

I.

THE Geological Society of America assembled in Montreal, December 28th, for its

tenth annual meeting. The Council met at 10 a. m. and performed the usual routine business of canvassing the votes for officers and new members and the reports of the Secretary, the Treasurer and the Editor. The Society held its first formal session at 2:30 p. m. in the lecture room of the Peter Redpath Museum of McGill University. This is the lecture room in which for so many years Sir J. William Dawson, past President of the Society, delivered his lectures, and it was felt by all present to be peculiarly appropriate that the Society should gather within its walls. One of the first proceedings was to send a greeting to Sir William, who was prevented by illness from being present.

A cordial address of welcome was presented by George Hague, Esq., of the Board of Governors of McGill University, who happily referred to the ties that unite men of science and that recognize no political boundaries. President Orton, of the Society, returned a felicitous response to the address of welcome, after which the report of the Council was distributed in printed form. This showed the Society to be in a very prosperous condition. There are 242 members on the roll, which with the four elected at the meeting make a total of 246. As will readily appear, this number embraces practically all the geological workers in North America. The *Bulletin*, the published proceedings of the Society, is meeting with a gratifying sale outside of the active members. From this source the past year $772.05 were realized, which defrayed about half the expense of publication. The Society has an invested fund of $3,000, and closed the fiscal year November 30, 1897, with a further balance in the Treasurer's hands. This will make possible the more elaborate illustration of future papers. The Society has now a valuable library from exchanges, and this year added a librarian, Professor H. P. Cushing, of Adelbert College, Cleveland, to its list of officers. The library is placed in Cleveland, which is a central point as regards the membership.

When the vote was declared, the following nominees were announced as elected by an almost unanimous ballot:

President: JOHN J. STEVENSON, New York City.

First Vice-President: BENJ. K. EMERSON, Amherst, Mass.

Second Vice-President: GEORGE M. DAWSON, Ottawa, Ont.

Secretary: H. L. FAIRCHILD, Rochester, N. Y.

Treasurer: I. C. WHITE, Morgantown, W. Va.

Editor: J. STANLEY-BROWN, Washington, D. C.

Councillors: W. M. DAVIS (for unexpired term of B. K. Emerson), ROBERT BELL, Ottawa, Ont.; M. E. WADSWORTH, Houghton, Mich.

John M. Clarke, of Albany; George L. Collie, of Beloit; Arthur M. Miller, of Lexington, Ky., and James E. Talmage, of Salt Lake City, were elected Fellows. Two proposed amendments to the constitution were carried. Professor W. B. Scott delivered an appreciative and impressive memorial of Edward D. Cope; and one of Joseph F. James, prepared by T. W. Stanton, was read by J. F. Kemp, in the absence of its author. The reading of papers was then begun.

Notes on the Sands and Clays of the Ottawa Basin. R. W. ELLS, Ottawa, Canada.

Dr. Ells included in the area discussed the region lying between Lakes Huron, Erie and Ontario, and the Ottawa river. He gave a brief review of the rocks lying to the north, which have been the source of the loose materials now forming the surface deposits. The sands and the marine clays, so prolific in shells, and several kame-like ridges were described, and the evidence of submergence beneath the sea was adduced at length. In general the interpretation corroborated the views already urged by Sir J. William Dawson, and widely familiar.

The discussion was quite protracted and developed a variance in interpretation on

the part of the several speakers. The close connection of the glacial lakes, the precursors of the present Great Lakes, with the sands and clays was brought out; the presence of marine and fresh-water shells and the evidence of differential uplift all came up. The discussion was sustained by Messrs. Scott, Taylor, Ami and Coleman.

Topography and Glacial Deposits of the Mohawk Valley. ALBERT PERRY BRIGHAM, Hamilton, N. Y.

The present topography of the Mohawk Valley was described and some probable features of the ancient drainage stated. The Mohawk was considered as a monoclinal valley following the outcrop of the Utica and Hudson River shales which had diverted the southern Adirondack drainage by headward cutting west to Little Falls. Further evidence for the divide located by Chamberlin at this point was given in the valley filling and arrangement of streams to the westward. A possible discharge of the West Canada Creek into the main valley west of Utica was suggested. The Mohawk faults were reviewed in their bearing on the maturing of the valley. The westward movement of the lower Mohawk Valley glacier was confirmed by some additional evidence. The drift deposits fall into three groups, viz.: terraces and deltas west of Utica; terraces, kames and other morainic masses between Utica and Little Falls; terraces of massive till mantled by sands and clays, below Little Falls. The drift of the valley was described as representing lacustrine and fluviatile phases of ice retreat, and some reasons were given for a discharge prolonged and strong, but not of great depth.

The paper was illustrated by a good map and was listened to with deep attention, as so many of the fellows were familiar with the region. The evidence of stream robbing by the Mohawk in its upper portion and the diversion of the southwest Adirondack drainage to the Hudson was striking.

The paper was discussed by F. B. Taylor. At its conclusion the Society adjourned until 8:30 p. m., at which time it reconvened in the Physics lecture room of the University, to listen to the presidential address of the retiring President, Professor Edward Orton. The subject was 'Geological Probabilities as to Petroleum' and was an able review of the hypotheses advanced regarding oil and gas. The speaker was happily introduced by Dr. George Dawson, Director of the Canadian Geological Survey.

On Wednesday, at 10 a. m., the meetings were resumed. Before the reading of papers was begun the Committee on Photographs presented a report from its Chairman, Dr. George P. Merrill, of Washington. The report showed that 134 new photographs had been received during the year, bringing the number up to 1,558. The Committee has also received a collection of 300 negatives taken by the Second Geological Survey of Pennsylvania. An exhibition of the pictures now in the possession of the Society was made in an adjoining room, and it was evident that a wealth of illustrative material for geological instruction has been made available, from sources, such as survey negatives, that are not usually accessible.

The Topography and History of Jamesville Lake, N. Y. EDMUND C. QUEREAU, Syracuse, N. Y.

Jamesville Lake is one of a class of small lakes in central New York which are often called 'Round Lakes,' a term which distinguishes them well from the 'Finger Lakes.' It lies between two of the main valleys (Onondaga and Butternut) which dissect in this region the New York plateau in a general south-north direction. The portion of the plateau between these two valleys is dis-

sected also, but not so deeply, by a series of small parallel west-east gorges or ravines, in one of which, the Jamesville gorge, the lake is situated. The immediate vicinity of the lake is channeled in a complicated manner by abandoned stream beds which run west-east, and whose sides are often terraced in such a manner as to make it evident that large quantities of water once passed across this region. Associated with these channels a number of kettle-like depressions are found, of round or oval outline and of varying dimensions. It is in one of the largest of these that the present Jamesville lake is situated. The lake basins were explained as probably caused in each case by a waterfall, which had hollowed out a depression or great pool at its foot.

The paper was discussed by W. M. Davis, who corroborated, from his own observations in the region, the views of the author; by H. L. Fairchild, who commented on the altitudes, and by F. B. Taylor, who connected the streams with the drainage of the glacial Lake Warren. This led to some estimate of the probable size of the river, and it was stated by A. P. Brigham and W. M. Davis to have been less than the present Niagara.

Notes on the Moraines of the Georgian Bay Lobe of the Ice-sheet. FRANK B. TAYLOR, Fort Wayne, Ind.

When the ice-sheet had retreated in the basin of Lake Huron so far as to leave the summit of Blue Mountain south of Georgian Bay uncovered, there still remained a well defined glacial lobe projecting towards the southeast nearly to Toronto and eastward beyond Lake Simcoe. This lobe was divided in two parts by the Penetang peninsula, the larger one extending southeast from Nottawasaga Bay, and the smaller one extending east-southeast from Matchedash Bay. Recently the moraines of the eastern limb of the Nottawasaga lobe were partially explored and a well defined series of five was found filling the interval from the head of Georgian Bay to the 'Oak Ridges' north of Toronto. During the later stages of this lobe there was a glacial lake covering Lake Simcoe and a considerable area to the east, and probably held up on that side by a lobe projecting from the northeast up the valley of the Trent River. Its beach is 90 to 100 feet above the Algonquin beach, a few miles northeast of Barrie. Well marked glacial striæ were found on the summit of the promontory of Blue Mountain, over 1,100 feet above Georgian Bay, running S. 60° E. Some of the moraines running along the east side of Lake Huron were also traced northward to the vicinity of Durham and Flesherton.

T. C. Chamberlin inquired regarding the direction of the glacial striæ as bearing on the views advanced, and the speaker replied that they bore S. 60° E. wherever visible. This brought out the observations of H. M. Ami that striæ in Ontario to the southwest of this region run southwest, and Robert Bell stated that they run southeast on Georgian Bay, but that at its north end they change to southwest. Robert Chalmers referred to the ridges, like drumlins, along Lake Ontario, on the line of the Pacific Railroad, and remarked that the associated striæ were variable from southeast to southwest. I. C. White asked about the height of the old Algonkian beach above Lake Simcoe, and F. B. Taylor replied that it was about 100 feet above the lake, which latter is 720 feet above tide.

Notes on the Geology of Montreal and Vicinity. FRANK D. ADAMS.

By means of the geological sheets of the Canadian Survey, Dr. Adams outlined the extent of the several formations from the old Laurentian gneisses, anorthosites and crystalline limestones on the north across the Paleozoic plain to the south. He gave

a brief description of the curious volcanic plugs now remaining as Mt. Royal and several others in an easterly line from it, and in a few words referred to their interesting petrographical character. The remarkable survival of Lower Helderberg strata in a patch of a few square feet on an island in the St. Lawrence, near Montreal, excited great interest, especially in their bearing on the views lately advanced by H. S. Williams on the line of entry of the late Silurian fauna into New York. The post-Pliocene deposits in the shape of the boulder clay; the bouldery gravels and stiff overlying clay; the Leda-clay and the Saxicava sand, all of which are carved into the marine beaches which now form the terraces on which the city is built, received passing mention. The way in which the geological structure had determined the location of the city and the settlement of the country was the closing topic of the paper.

The discussion turned at first on the determining factors in the present relations of of the ancient crystallines and the paleozoics, and whether the rather straight contact shown on the map is the result of faulting or of the creeping-up of the Cambrian sea on an even shore-line. Dr. George Dawson and several other Canadian geologists said that there were no faults, but that the inroad of the sea had brought about the phenomena. The discussion then turned on the course of events, in the region in the times after the latest paleozoic sediments and before the superficial deposits had accumulated, and developed the fact that it is easy to ask questions which no Fellow can answer. The discussion also turned on the Helderberg outlier and its relation to the older Ordovician strata. It was shown to rest on a curious tufa deposit, but, as remarked by H. M. Ami, the Devonian to the east rests unconformably on the Cambrian. The discussion was participated in by H. P. Cushing, H. M. Ami, W. M. Davis, George M. Dawson, J. H. Tyrrell, R. W. Ells and F. B. Taylor.

Marine Cretaceous Formations in Deep Wells in Southeastern Virginia. N. H. DARTON.

The paper was read by W. N. Rice, in the absence of the author. It recorded the sections recently revealed by deep wells at Norfolk, Va., Fortress Monroe, Lambert's Point and Jetty Point. They show that the marine Cretaceous, which was thought to be growing thin in southern New Jersey, thickens again farther south.

The Cretaceous Series of the West Coast of Greenland. CHARLES SCHUCHERT and DAVID WHITE.

The paper was presented by David White and described the results obtained the past summer while exploring the plant beds along the Nugsuak peninsula. On a base of gneisses lie 3,000 feet of sediments forming the plant beds, and on these, 4,000 feet of basalt flows. The beds dip away from the gneisses and are available between tidewater and the basalt, which covers their upturned edges and pierces them in dikes. The stratigraphical section, with the European equivalents, is as follows:

$$\left.\begin{array}{l}\text{Patoot} = \text{Senonion}\\ \text{Atane} = \text{Cenomanian}\\ \text{Kome} = \text{Urgonian}\end{array}\right\}\text{Cretaceous}$$

All corresponded to the American Potomac formation, except, perhaps, the Patoot. Marine fossils were also found, giving the offshore equivalents of the plant beds. The latter are remarkable in affording dicotyledons. W. B. Scott asked about the equivalency of the Potomac, to which the speaker replied that it would be fully discussed in an early paper by Dr. L. F. Ward. T. C. Chamberlin inquired as to the climatic conditions as indicated by the Potomac floras north and south. Mr. White replied that they showed no climatic

differences, and that the Nugsuak plant beds filled up hollows in the gneisses, and were not very different now in their position as regards the sea from that occupied at the time of their deposition.

(*To be concluded.*)

J. F. KEMP.

COLUMBIA UNIVERSITY.

THE SECTION OF ANTHROPOLOGY AT ITHACA.

IN accordance with an arrangement made at Detroit, a meeting of Section H (Anthropoloy) of the American Association for the Advancement of Science was held at Cornell University, at Ithaca, December 29 and 30, 1897.

On Wednesday morning, December 29th, the Section organized with Vice-President W J McGee in the chair and Dr. A. Hrdlicka as Secretary *pro tem.* Immediately afterward the session adjourned to permit the members to attend the meeting of the American Psychological Association then in progress, and to unite with the American Society of Naturalists during the afternoon.

The Section reassembled for the reading of papers Thursday morning. The first communication was a full account of the elaborate 'Mythology of the Bella Coola,' by Dr. Franz Boas. After describing the beliefs of this remarkably interesting Indian tribe, the author proceeded to a comparison of these beliefs, and the ceremonies by which they are attended, with those of neighboring tribes, and discussed the development of myths in general as well as the special lines of mythic development traced among the Bella Coola. Comments were made by Dr. Farrand, Professor Cattell and Dr. Beauchamp.

This was followed by a paper on the 'Loss of Aboriginal Arts and its Significance,' by Rev. W. M. Beauchamp, in the course of which the author emphasized the transformation in the aboriginal arts of central New York attending the incursion of conquering tribes.

On behalf of the Committee of the Association on 'The Ethnography of the White Race in the United States,' Dr. Boas made a brief report of progress.

The next communication was an illustrated account of 'Dwellings of the Saga Time in Iceland, Greenland and Vineland,' by Miss Cornelia Horsford. Beginning with a description of the Norse Sagas, covering the period A. D. 875–1025, Miss Horsford noted the recent researches concerning the habitations described in the Sagas. None of these have thus far been identified in Denmark, Sweden or Norway, but several have been identified with considerable certainty in Iceland, chiefly through the investigations of the Icelandic Antiquarian Society, and also in Greenland, while a few have been identified with fair certainty in the 'Vineland the Good' of the Sagas—what is now eastern Massachusetts. The houses of the three countries were illustrated and shown to be essentially similar by means of photographs and sketches of the ruins, and were identified in design and other characteristics with the house-types still surviving in Iceland. The paper was discussed by Dr. Boas, who pointed out the essential distinctness of the habitations described from those of the aborigines of America, including the Eskimo. Remarks concerning the extent and thoroughness of the investigation were also made by Dr. Beauchamp and the presiding officer.

The afternoon session began with a brief paper on 'Eskimo Boot Strings,' by John Murdoch. This was followed by an extended 'Preliminary Report on the Somatology of the Tribes of Northwestern Mexico,' by Dr. A. Hrdlicka, in the course of which a large number of crania from Mexico and the United States were described, while the distribution of the types

was indicated. Dr. Boas and others contributed supplementary information.

'Views of the Paleolithic Question,' by Rev. Stephen D. Peet, and 'The Collection of Anthropometric Data,' by Professor J. McKeen Cattell, were read by title.

The next communication was presented under the title 'Conditions attending the Rise of Civilization,' by W J McGee. The author pointed out that the development of civilization on the shores of the Mediterranean was attended by growing recognition of proprietary right in land, together with concomitant recognition of the territorial rights of others, and the gradual growth of law relating to boundaries, monuments and inheritances. He gave special emphasis to the altruistic character of the laws regulating territorial interest. Considering, then, the characteristics of life in desert regions, he showed that the tendency of common strife against hard physical environment is toward the development of an intimate coperation and interaction of such sort as to simulate the altruism of civilization. He then touched briefly on the influence of desert conditions in promoting the recognition first of custom and then of law corresponding to the customs and laws of advanced culture. The communication was discussed by Professor J. Mark Baldwin, Dr. Farrand and Dr. Boas.

An informal symposium followed on the question 'Will Winter Meetings Meet the Need of American Anthropologists for Organization?' It resulted in a decision to recommend to the Association that provision be made for a meeting of the Section of Anthropology to be held in New York during the Christmas holidays of 1898. Incidentally the need of a medium for the publication of anthropologic papers received consideration, and a special committee was appointed and given power to act toward the establishment or adoption of an American anthropological journal, the committee consisting of Messrs. Boas (chairman), Brinton, Putnam, Frank Baker and McGee.

The Section adjourned at 5 p. m. to meet with others at Boston.

W J McGee,
Vice-President Section H.

ALONZO S. KIMBALL.

Professor Alonzo S. Kimball, who was for a quarter of a century professor of physics in the Worcester Polytechnic Institute, was born at Center Harbor, New Hampshire, in 1843. He was prepared for college at New Hampton Academy, and was graduated from Amherst College in 1866. In 1871 he was called to the Worcester Polytechnic Institute, which had just graduated its first class. He organized the department of physics, and the Institute was among the first in the country to provide systematic instruction in a physical laboratory. After seven or eight years of great activity and usefulness, shown alike in the development of the important department of which he had charge, and in a series of valuable original contributions to physical science, he was, in 1879, attacked by a painful disease, which, in spite of the highest medical skill in both this country and Europe, proved to be incurable, and from the effects of which he died on December 2, 1897. Notwithstanding the steady progress of a malady which entailed nearly continuous suffering, Professor Kimball, through all these years, discharged the constantly increasing duties of his position to the great satisfaction of the officers of the Institute and of the hundreds of pupils to whom his life and work were always inspiring. In addition to his regular work in Worcester, he was for several years a lecturer at Mt. Holyoke College, of which institution he was for many years and at the time of his death a Trustee. While the Salisbury Laboratories of the Polytechnic Institute were being built he spent a year

in Europe, engaged in the study of the best European establishments, and in selecting apparatus for the better equipment of the new building to which his department was to be transferred. While there he suffered from a more than usually acute attack and submitted to a difficult and dangerous surgical operation, which it was hoped might lead to a permanent recovery. Only temporary results followed, however, and within the past five or six years several similar operations were performed with the same result. His work in the lecture room and laboratory was not seriously interrupted, although carried on under conditions that would have made it impossible with most men. When, ten or fifteen years ago, the creation of a new branch of engineering began, Professor Kimball was not slow to appreciate its importance, and the Institute was among the first schools of applied science to offer a course in electricity with ample equipment of electrical machinery and other appliances necessary to its success. The management and development of this course, along with the courses in pure physics, remained with him until about two years ago, when its magnitude became such that it was necessary to set off the electrical engineering as a separate department with a special professor at its head. With lessened responsibility, his enthusiasm and, for a time, his activity greatly increased, but his enjoyment of the new conditions was cut off by his death, a few weeks ago.

Professor Kimball was uncommonly skillful in experiment, possessing originality in design and his work was done with that sense of refinement and precision which is essential to original research. Between the years 1875 and 1880 he published in various scientific journals a series of papers, each the result of wisely planned and carefully conducted experiment and all of much value. The first was on 'Sliding Friction,' published in the *American Journal of Science*, March, 1876. It marked the beginning of an important investigation of the general subject of friction, the results of which were published in subsequent numbers of the same journal, in Van Nostrand's *Engineering Magazine* and elsewhere. In these papers he shows that friction between sliding surfaces is independent of neither velocity nor pressure, experiment pointing to the existence of a maximum coefficient of friction depending on both velocity and pressure. During these years there were also other papers on the influence of temper upon the physical properties of steel, the effect of magnetization on the physical properties of iron, etc. There was also prepared and printed a small treatise on thermodynamics, arranged especially for the use of his pupils, exhibiting much originality and clearness in method of presentation.

From the quality of Professor Kimball's work during this period there can be little doubt that he would have achieved marked distinction in his chosen field but for the failure of his health, from which he never recovered. From 1879 to his death, a period of nearly twenty years, his fight was against odds that must have long ago defeated any one endowed with only the average human courage and tenacity of purpose. Conscientiously discharging every duty that the day brought, he had little energy left for research work, although he published occasional papers and was always anxious to utilize any temporary increment of vitality in that way.

Although a member of numerous scientific societies, Professor Kimball was rarely seen at their meetings, his long illness thus standing in the way of those intimate personal and social relations with his confreres for which he was by nature so admirably fitted. His manner was charming, his good nature unceasing, his instincts fine and noble.

To those with whom he was associated in work, or who were otherwise privileged to know him intimately, his prolonged but splendidly heroic struggle with a fatal disease, together with the uniformly high standard of performance which that struggle did not sensibly affect, will ever remain an inspiring example of the best of human qualities.

T. C. M.

CURRENT NOTES ON PHYSIOGRAPHY.

MILNE ON SUBOCEANIC CHANGES.

This topic, already noted in Science (September 3, 1897), receives further details (London Geog. Journ., X., 1897, 259–289), which will well repay study. Their practical importance may be inferred from the expense—half a million sterling—of fifteen cable repairs necessitated by submarine disturbances. Their specific character appears in the items of place and date, as well as in the photographic illustrations of torn cables, gathered by the author with much care from usually inaccessible sources. Their novelty is illustrated in such items as the following: "The Bilbao cable broke down periodically, usually in March during or after a heavy northwest gale, at a point about thirty miles off shore; when repaired, it was invariably found that three or four miles of cable had been buried. This is attributed to a strong submarine current, caused by the piling up of surface water by the wind; the under current crossing the drowned prolongation of a river valley with steep walls, which, when undercut, fell in masses." Again: "The military and naval reserves were called out in Australia, in 1888, when the simultaneous interruption of two cables cut off communication with the rest of the world for nineteen days and gave rise to the fear that war had broken out in Europe." The physiographical interest of the article comes from the constant association of cable fractures with the steeper slopes of continental margins where the submarine contours are not only irregular but variable; this being in strong contrast to the undisturbed condition of cables in deep water on a soft level bottom, of which Kipling says:

> There is no sound, no echo of sound, in the deserts of the deep,
> Or the great gray level plains of ooze where the shell-barred cables creep.

Near the continents, slopes of 1 in 7, or even 1 in 3 are discovered. Changes of depth amounting to 100 or 200 fathoms are determined by soundings before and after cable fractures in regions of disturbance.

In conclusion, Milne makes two suggestions: First, that he would be glad to receive (at Shide Hill House, Newport, Isle of Wight, England) details regarding cable interruptions in any part of the world; second, that seismographs, similar to the one he has on the Isle of Wight, should be installed in various countries, their cost being about £50; this suggestion being adopted by the British Association, whose circular on the subject may be obtained from their Seismological Committee (Burlington House, London, W.).

HATCHER'S EXPLORATIONS IN PATAGONIA.

Primarily with the object of collecting fossil mammals, Princeton University sent J. B. Hatcher to Patagonia in January, 1896. He returned in July, 1897, and after leaving reports on his geological and geographical results (*American Journal of Science* and *National Geographical Magazine* for November) he has gone out on a second expedition. The geographical description gives an excellent picture of the Patagonian pampas. They consist of a heavy series of fresh-water (continental) deposits, deeply cut by west-east valleys and strewn over with drift from the Andes, morainic near the mountains and water-washed farther east. The terraces, by which succes-

sive plains descend toward the Atlantic, famous since Darwin's voyage, are accounted for as sea cliffs, cut during the recovery from a period of depression after the valleys had been eroded. Volcanic cones and lava flows give some variety to the region. Salt lakes are barred in valleys behind the sand reefs of the former shore lines, and their salt is explained as having been retained since a part of the ocean was there enclosed. This conclusion, as well as the implication that salt lakes are usually supplied by salt springs, seems open to question; but as a whole the geographical descriptions are much more lucid than those that one usually meets in geographical magazines.

THE ST. CROIX DALLES, MINN.

A THESIS by C. P. Berkey, University of Minnesota, discusses the 'Geology of the St. Croix Dalles' (*Amer. Geol.*, XX., 1897, 345–383) and throws much light on the geography of the district, which seems to be one of special interest. Cambrian strata lying unconformably on pre-Cambrian igneous masses constitute the bed-rock of the region. Heavy glacial deposits, morainic and washed, overspread the bed-rock and determine much of the surface form. Large glacial rivers and the discharge of the glacial West Superior lake have carved important valleys, of which the rock-walled dalles attract most attention. Several abandoned river-courses contain lakes, some of which seem to belong in the rare species of pools excavated by the plunge of extinct falls.

SURFACE CURRENTS OF THE NORTH SEA.

OBSERVATIONS made for the Fishery Board of Scotland on the surface currents of the North Sea, chiefly by means of floating bottles, are discussed by T. W. Fulton (*Scot. Geogr. Mag.*, XIII., 1897, 636–645). A tolerably regular circulation around the margin of the sea is found at an average rate of two or three miles a day, southward on the west, northward on the east side of the sea. The velocity varies with the winds, and after a period of unusual and persistent southeasterly winds in December, 1896, and January, 1897, the current was reversed along the coast of Great Britain. The currents are, therefore, ascribed to the prevailing westerly winds, which drive the water towards the eastern side of the sea and tend to heap it up there. In the firths the currents are irregular, varying with winds and tides.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

THE UNITY OF THE HUMAN SPECIES.

LITTLE is now written about 'monogenism' or 'polygenism.' To the physical anthropologist that question is quite absorbed in the wider one of 'variation.' But the psychical unity of the species is still lacking definition. A noteworthy contribution to it is one by the Marquis de Nadaillac in the *Revue des Questions Scientifiques* for October last. He points out the unending similarities in implements, arts, funeral rites and religious symbols in tribes of like stages of culture in all times and places.

That these are proofs of psychic identity there can be no doubt. But it is not quite clear how the author interprets them. In some passages he speaks of such customs and inventions being 'handed down from unknown ancestors by generation to generation;' while elsewhere he says the solution lies 'in the identity of the mind of man in all periods and in all regions.' The latter is the position which is most acceptable to the trained ethnologist.

LOCAL ETHNOGRAPHIC COLLECTIONS.

IN the rapid changes of American history the mode of life of one generation is scarcely known to that which follows it. Hence the value of collecting, while we can, those ob-

jects which represent how our near ancestors worked and played. No recent publication better illustrates how much of worth there is in such a collection than a descriptive catalogue of objects in the Museum of the Historical Society of Bucks County, Pa., prepared by Mr. Henry C. Mercer. It bears the felicitous title 'Tools of the Nation Maker,' and is handsomely printed and covered. The notes, folk-songs, etc., which the author adds render it much more than a catalogue, and the index is a model of completeness. Copies can be obtained through Mr. Mercer (Doylestown, Pa.).

RACIAL GEOGRAPHY OF EUROPE.

ON previous occasions attention has been called in these notes to the excellent series of articles on the racial geography of Europe contributed by Professor W. Z. Ripley to the *Popular Science Monthly*. The eleventh instalment, that in the December number, dealt with the British Isles, and is of special interest to English-speaking peoples. In preparing it Professor Ripley was actively aided by members of the Anthropological Institute of Great Britain, and officially by that institution itself. His article, therefore, represents the most recent and thorough scientific study of the population of the British Isles.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

THE UNITED STATES FISH COMMISSION.

As directed by the American Society of Naturalists, Professor Henry F. Osborn presented to President McKinley, on January 7th, the resolution passed by the Society at the Ithaca meeting, and published in the last issue of this JOURNAL. As it is desirable to give this resolution the widest possible circulation, it may be repeated:

"*Resolved*, That the American Society of Naturalists, as representatives of the principal scientific and educational interests of this country, unanimously express to the President and Congress of the United States their sentiment that the Commissioner of Fish and Fisheries should, according to the law of 1888, governing his appointment, be 'a person of proved scientific and practical acquaintance with the fish and fisheries of the coast.'

"*Resolved*, That it is of the utmost importance that the Fish Commission, as one of the most useful scientific institutions of the government, should be free from political influence and should be administered with the highest degree of scientific efficiency by an experienced officer."

The President received the resolution very courteously and replied that he recognized it as representing the sentiment of all the institutions of the country, and that the United States Fish Commission should coöperate with the colleges as originally planned by Spencer F. Baird. His decision in the matter of appointment will not be made public at present.

THE WASHINGTON ACADEMY OF SCIENCES.

ON September 15, 1897, the Council of the Geological Society of Washington invited the other societies represented in the Joint Commission of the Scientific Societies of Washington to appoint 'a committee of conference, to meet similar committees from other societies,' for the consideration of certain questions relating to the joint organization of the scientific societies. In response to this invitation, the following committees were appointed: From the Anthropological Society, Frank Baker, W J McGee, Lester F. Ward; from the Biological Society, L. O. Howard, C. Hart Merriam, George M. Sternberg; from the Chemical Society, C. E. Munroe, W. H. Seaman, Wirt Tassin; from the Entomological Society, W. H. Ashmead, Theodore Gill, C. L. Marlatt; from the National Geographic Society, Henry Gannett, G. K. Gilbert, Gardiner G. Hubbard; from the Geological Society, Whitman Cross, S. F. Emmons, Arnold Hague; and from the Philosophical Society, Marcus Baker, J. R. Eastman, Bernard R. Green. This Committee of Conference met on December 6 and organized by the election of J. R. Eastman as Chairman and Whitman Cross as Secretary; other meetings were held on December 9 and 11. After full discussion, the following resolutions, among others, were

adopted and recommended to the governing boards of the several scientific societies:

"*Resolved,* That in the judgment of this Committee, the autonomy of the several scientific societies should be maintained.

"*Resolved,* That in the judgment of this Committee the Joint Commission should be modified in the following particulars:

1st, That its name be changed to the Washington Academy of Sciences; 2d, That it assume independent scientific functions; 3d, That it have power to add to its members.

"*Resolved,* That the Committee therefore recommends to the several societies that they instruct the Joint Commission to take such action as may be necessary to carry the above recommendations into effect."

The conferees subsequently reported their action to the governing boards of the several societies, and all of these have adopted the resolutions substantially as voted by the Committee of Conference. The matter comes up for action at a special meeting of the Joint Commission on January 11th.

THE SWEDISH ARCTIC EXPEDITION OF 1898.

THE preparations for this expedition are described in a recent issue of the London *Times.* It will be under the leadership of Dr. A. G. Nathorst, who accompanied Nordenskjöld in his Greenland expedition of 1883. Its main object is to examine the eastern side of Spitzbergen, Wiche's Land and New Island—in short, the region between Spitzbergen and Franz Josef Land. But, as this area will probably not be accessible in the beginning of next summer, Dr. Nathorst intends to carry on investigations in western Spitzbergen, Northeast Land, Bear Island, etc. He has bought the 'Antarctic,' which in 1895 carried the whaling expedition to the South Polar Sea; it is now being overhauled and equipped for the expedition. The captain will be Emil Nilsson, who has been several times to the Yenisei and who commanded the 'Sofia' during Nordenskjöld's Greenland expedition in 1883. Dr. Nathorst himself will have special charge of the geological work. The zoologist will be Mr. G. Kolthoff, of Upsala, curator of the fine biological museum at Stockholm. He also was in the 1883 expedition, and has made ornithological expeditions to Iceland and the Farös. Dr Axel Ohlen, of Lund, will also look after the zoology. He has dredged off the east coast of Greenland, has visited Baffin's Bay and Melville Bay, and was in the recent Swedish expedition to Tierra del Fuego. Dr. Gruner Andersen will be the botanist. He has studied the Arctic flora on the mountains of Sweden and Norway. The hydrographer will probably be Dr. Axel Humberg, also a well-known geologist; he also was in the 1883 expedition. The hydrographical work will form a very important part of the researches of the expedition. The cartographical work will be under the charge of Lieutenant Otto Kjellström; in this department photographic methods will be utilized as an aid to the ordinary methods. Special attention will be given to glaciers wherever found, and the surgeon, Dr. E. T. Levin, will investigate the occurrence of bacteria in the Arctic regions.

GENERAL.

THERE were in attendance at the Ithaca meeting of the American Society of Naturalists and Affiliated Societies 166 members coming from 47 institutions.

AMONG those who have accepted nominations as Vice-Presidents of the General Committee of the Fourth International Congress of Zoology are the following: Professor R. J. Anderson, of Belfast; Professor Bridge, of Birmingham; Professor D. J. Cunningham, of Dublin; Professor Herdman, F.R.S., of Liverpool; Professor M'Intosh, F.R.S., of St. Andrews; Mr. J. Cosmo Melvill, of Manchester; Professor Lloyd Morgan, of Bristol; Professor Alleyne Nicholson, F.R.S., of Aberdeen; Dr. Scharff, of Dublin; Dr. Traquair, F.R.S., of Edinburgh; Canon Tristram, F.R.S., of Durham; Lieutenant-Colonel R. G. Wardlaw Ramsay, and Professor Percival Wright, of Dublin.

As we learn from *Nature,* the Council of the London Chemical Society have recommended the following as foreign members to be balloted for at the next meeting, January 20th: Professor Remsen, Baltimore; Professor Troost, Paris; Professor Moissan, Paris; Professor Raoult, Grenoble; Professor Oswald, Leipzig; Professor Curtius, Bonn; Professor Mensutkin, St. Petersburg; Professor Markownikow, St.

Petersburg; Professor Arrhenius, Stockholm; Professor Waage, Christiania; Professor Franchimont, Leyden; Professor van der Waals, Amsterdam; Professor Spring, Liége; Professor Körner, Milan.

Sir W. H. Flower has been elected associate of the Royal Academy of Sciences, Belgium.

Queen Victoria has conferred among the usual New Year honors the following: knighthood on Professor George Brown, Consulting Veterinary Advisor to the Board of Agriculture; Ernest Clarke, Esq., Secretary to the Royal Agricultural Society; John Struthers, M.D., LL.D., late President of the Royal College of Surgeons of Edinburgh, and John Batty Tuke, Esq., M.D., President of the Royal College of Physicians of Edinburgh; The K.C.B. on Professor Gairdner, Dean of the Faculty of Medicine, Glasgow University, and the C.B. on Professor D'Arcy Thompson.

A bronze bust of the late General Francis A. Walker, of the Massachusetts Institute of Technology, was presented formally by the undergraduate students to the Institute of Technology, on January 5th, the anniversary of General Walker's death.

Dr. A. D. Waller has resigned from the Fullerian professorship of physiology and comparative anatomy of the Royal Institution owing to the lack of any facilities for physiological research.

Mr. W. P. Pycraft has left Oxford, according to *Natural Science*, and has been appointed temporary assistant in ornithology in the British Museum (Natural History). He will devote his attention specially to the arrangement of the collection of skeletons of birds.

Governor Black has appointed the following as delegates to represent the State of New York at the Fisheries Congress to be held at Tampa, Fla., on January 19th: Tarleton H. Bean and Warren N. Goddard, of New York City; Charles L. MacArthur, of Troy; Charles L. Babcock, of Rochester; Edward Thompson, of Northport, and A. Nelson Cheney, of Glens Falls.

News has just been received of the death of Professor Thomas Jeffery Parker, F.R.S., on November 7th, at Dunedin, New Zealand. Professor Parker was from 1872 to 1880 demonstrator in biology at the Royal College of Science. He then went to New Zealand as professor of biology in the University of Otago, where he did much to promote the advancement of natural science in the colony both by his lectures and addresses and by founding the Otago University Museum, of which he was curator at the time of his death. In 1884 he published 'A Course of Instruction in Zootomy (Vertebrata),' and a 'Text-book of Zoology,' written jointly with Professor W. A. Haswell, was completed before his death and will be published by the Macmillans.

Dr. Ernest Hart, since 1866 editor of the *British Medical Journal*, died in London on January 7th. He had made the *Journal*, perhaps, the leading medical journal of the world, only rivalled by the *Lancet*, and had at the same time built up the British Medical Association to be probably the strongest professional organization in the world. Dr. Hart was the author of many publications and was prominent in numerous and important sanitary and social reforms.

We regret also to record the death of Professor Francesco Brioschi, the mathematician, President of the Accademia dei Lincei, at Milan, on December 13th, aged seventy-two years; and of Professor James Holm, professor of physics at the South African College, Capetown, and before 1895 demostrator in physics at University College, Nottingham, aged twenty-eight years.

The *Science Teacher* is the name of a monthly publication just established by Mr. A. T. Seymour, instructor in science and mathematics, Westminister School, Dobbs Ferry, N. Y. There is room for a scientific journal that will be of interest to teachers in the secondary schools, and we hope that this journal will fill the place, but in order to do this it will be necessary to improve upon the first number.

The *Philadelphia Medical Journal*, established under the auspices of the leading physicians and medical men of Philadelphia and edited by Dr. George M. Gould, has begun publication with the New Year. The first number contains

contributions from Dr. J. M. Da Costa, Professor N. Senn, Professor William Osler, Professor W. W. Keen and other distinguished contributors. Much space is devoted to editorials, notes and a review of the contents of other medical journals in the English language. Under its present editorship the *Journal* is sure to be interesting and agressive, as witness the following from the editorial columns: "Because a city [*i. e.*, New York] has a great harbor it is boobyishness to boast and be proud. * * * * * It will require a good many years before the supremacy of Philadelphia as the medical center of America will be seriously disputed. But we are less interested in the braggart's vaunt of any supremacy, etc."

AT a meeting of the Zoological Society of London on November 14th Mr. J. Graham Kerr gave an account of his recent expedition, along with Mr. Budgett, to the Chaco of Paraguay in quest of *Lepidosiren*, and made remarks on its habits as there observed. Mr. Kerr also gave a general account of the early stages of its development, drawing special attention to the presence in the larva of external gills and a sucker similar to those of the Amphibia. Mr. Oldfield Thomas, F.Z.S., read a paper entitled 'On the Mammals obtained by Mr. A. Whyte in North Nyasaland, and presented to the British Museum by Sir H. H. Johnston, K.C.B.; being a fifth contribution to the Mammalogy of Nyasaland.' This memoir contained notes on 61 species of mammals, 4 of which were characterized as new, viz, *Macroscelides brachyrhynchus malosæ*, *Crocidura lixa*, *Myosorex soulla* and *Graphiurus johnstoni*.

IN the *Journal* of the Boston Society of Medical Sciences, for December, 1897, Dr. C. F. Hodge gives 'some results of the action of alcohol on dogs as regards non-viability and malformation of the young, and severity of attack in an epidemic of distemper.' These observations, which are a continuation of the experiments described in *The Popular Science Monthly* for April, 1897, show that of the progeny of the alcoholic pair, twenty pups, born in three litters, eight were malformed and six born dead. The normal pair produced sixteen whelps in three litters, and not one of these was born dead, and only one was malformed. During an epidemic of distemper one of the alcoholized dogs died, and all save one were seriously affected; none of the other dogs exhibited any serious symptoms of disease.

THE monkeys in the vicinity of Hardwar, India, are said to be seriously affected with the bubonic plague, which they are supposed to have contracted through visits to infected rooms in the town of Hardwar. The proposed extermination of the monkeys with a view of putting an end to the disease so far as they are concerned might clash seriously with the religious views of the Hindoos.

MAYOR QUINCY, of Boston, in his inaugural message urgently recommends the establishment of a marine aquarium in Boston. He notes that for ten years or more the Boston Society of Natural History has been engaged in considering and endeavoring to carry through plans for natural history gardens, to be established within the parks under three different divisions—one, the marine aquarium, to be located at Marine Park; another, the fresh water aquarium, to be located at Jamaica Pond, and the third, the Zoological Garden, to be located in the Long Crouch Woods, Franklin Park. The total expense of carrying out the complete plans is estimated at $200,000, and Mayor Quincey strongly recommends them. He urges that $65,000 be appropriated at once for the marine aquarium.

GOVERNOR BLACK, of New York, in his recent message pays special attention to the forestry interests of the State. He proposes that the State should purchase a tract of forest land and cultivate it scientifically as a means of diffusing knowledge and showing the revenue-producing character of such an investment sagaciously administered. It should be kept clear of politics by giving the Regents of the University or the Trustees of Cornell University charge of it, and an annual report of progress and results should be made to the Legislature.

SENATOR PLATT, of New York, has introduced into the United States Senate a bill to establish a national park on the Palisades of the Hudson River.

A BILL which will limit the lawful use of hypnotism to licensed physicians will, it is said, be introduced into the New York Legislature during the present term. A number of instances have been collected to prove that the use of hypnotism by irresponsible persons is dangerous and opposed to the public good. The bill, before introduction, will be submitted to eminent lawyers for revision, and when finished will be supported, it is said, by the medical societies of the State.

BILLS have been introduced into the United States Senate and House of Representatives making appropriations for the continuation of timber tests by the Forestry Division of the Department of Agriculture. Senator McBride's bill appropriates $40,000, and Representative Hurley's $100,000.

AN appropriation of $200,000 is asked this year by the Gypsy Moth Committee, which has just made its annual report to the Board of Agriculture. The work of the past few years has convinced the Committee that extermination of the moth is not only possible, but certain, if sufficient sums be promptly appropriated for the purpose.

THE plaster casts used by Professor Osborn in his lecture on museums before the recent meeting of the American Society of Naturalists have been presented by him to Cornell University.

THE leading editorial in the January number of *Natural Science* endorses the article in the *Contemporary Review* on the fur-seals from which we recently quoted. The editorial concludes: "It may be retorted that if the Canadians are to be debarred from killing fur-seals at sea the Americans ought to be prevented from killing them on shore. But the conditions are totally different. On shore only non-breeding males with perfect skins are killed. No females or breeding males are taken. But at sea no such selection is possible; the sex cannot be determined until the seal is killed. Many of the seals escape with fatal wounds, and as the females are less active than the males, and are often hampered by the presence of their young, they are more easily captured. Hence the majority of the seals killed at sea are females. The economic value of the pelagic seal industry is now insignificant, and as it appears to be admitted by both sides that the herds of fur-seals are being greatly reduced in numbers by the excessive killing at sea of female seals, and the consequent starvation of nearly 20 per cent. of the young, it is to be hoped that effective measures may be taken to prevent this inhuman and wasteful slaughter."

THE new volume of 'Minerva' published by Trübner, Strassburg, has as a frontispiece an etching of Nansen.

Le Journal de Colmar, of December 12th, announces the translation of Hirn's 'Analyse élémentaire de l'Univers' into the Russian by General Starinkévitch. The translator informs the former secretary or personal friend of Hirn, M. E. Schwoerer, that the work is just issued and that he has prefaced to the text a biographical sketch of 'Hirn: sa vie et ses travaux.' General Socrate Starinkévitch is the Governor of Varsovie and one of the best known scientific men in Russia among the nobles of that rapidly developing country.

THE works of the United States Liquefied Acetylene Distributing Company, located at Jersey City, were completely destroyed by a series of explosions on December 24th. Two men were killed and others were injured. It is evident that the manufacture and use of acetylene should receive a thorough scientific investigation before it can take the place that its merits warrant.

THE royal British Antiquarian and Archæological Societies have lodged a petition with Lord Salisbury protesting against the peculiar form of prison labor in Egypt since the Khedive's penitentiaries and jails have been under English management, says the *Scientific American*. It seems that the convicts, of whom there are twelve hundred in the Jourah prison alone, are employed in manufacturing bogus antiques, for which there is reported to be a large market, especially in America. The petitioners declare that the forgeries are so clever as to be scarcely distinguishable from the real article. As yet only antiques of relatively small dimensions have been produced, but the prison authorities express the hope of being able in course of time

to turn out full-fledged mummies and sarcophagi. The scientific societies in England point out, with some degree of justice, that while this form of prison labor may have commercial advantages it practically renders the British government a party to fraud.

PER DUSÉN, the Swedish engineer and bryologist, has returned from Tierra del Fuego and Patagonia, where he has been engaged in scientific research since September, 1895.

AT a meeting of the Royal Colonial Institute, London, on November 21st, Mr. W. Saville-Kent, late Commissioner of Fisheries to the Government of Queensland, Tasmania and Western Australia, made an address on the natural history of Australia. Lord Loch, who presided, referred, at the close of the lecture, to the question of Antarctic exploration. He said there was a movement on foot at the present moment, which was receiving very strong support, for fitting out an expedition, and he trusted that the Council of the Institute would give that movement, when it came in a very short time prominently before the public, every support. This matter of exploring the Antarctic regions had long occupied the attention of the several colonies in Australia. During the time he was Governor of Victoria there was a strong feeling in favor of assisting any such movement. If the Imperial Government would have assisted in fitting out an Antarctic expedition these colonies, and he believed others, would have willingly joined. Whether circumstances that had since occurred in Australia would enable them now to join in any movement that might be brought forward by the Imperial Government he did not know, but he believed there would be a strong expression of opinion in Australia in favor of the southern colonies joining in any organized expedition, whether assisted by the government at home or promoted by private enterprise entirely, to carry out Antarctic exploration.

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT HARPER announced at the recent Quarterly Convocation of the University of Chicago that Mr. Rockfeller had given $200,000 to maintain the University in its present condition during the year beginning July 1st. It is announced that the Rush Medical School of Chicago, with 77 instructors and 699 students, will probably affiliate with the University of Chicago.

THE east wing of Ottawa University (Catholic) was destroyed by fire on January 5th. The loss on the building is $50,000 ; on contents $30,000. The loss is covered by insurance.

THE Educational Council of the Nebraska State Teachers' Association has adopted the report of a committee of which Professor Bessey is chairman, recommending that only those institutions be recognized as colleges that require as a minimum for admission the equivalent of a good high-school course of at least three years above the eighth grade of the public schools, and that give a full four-year course of collegiate work of creditable grade for graduation.

A CHEQUE for £1,000 from Mr. Alexander Peckover, Lord-Lieutenant of the county of Cambridgeshire, has been received by the Vice-Chancellor of Cambridge University for the fund for rebuilding the School of Medicine and Surgery atttached to the University.

THE establishment of a new technological institute in the north of Prussia is being discussed in the German papers, and is favored by several political leaders, including Dr. von Gossler, lately Minister for Education and the Fine Arts. Danzig, Thorn and Posen are mentioned as suitable places. Hamburg is also agitating the question, though that city seems to want a university.

MR. FRANCIS RAMALEY, instructor of pharmaceutical botany in the University of Minnesota, has been appointed assistant professor of botany in the University of Colorado, Boulder, Col.

PROFESSOR KELLY has resigned from the chair of hygiene in King's College, London.

DR. ABELOUS has been appointed professor of physiology at the University of Toulouse, and Dr. F. Stanley Kipping, F.R.S., professor of chemistry at University College, Nottingham, England. Dr. Hollerman has qualified as docent in botany in the University of Berlin.

DISCUSSION AND CORRESPONDENCE.

THE THIRD INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

To the Editor of Science: The great success of the Second International Congress of Applied Chemistry leads to the belief that the next one, which is to be held in Vienna in July, 1898, will also be numerously attended. Nearly 2,000 members were present at the Paris meeting, and it required five large volumes to contain the report of its proceedings.

The undersigned have been appointed a committee in the United States to promote the interests of the Third International Congress of Applied Chemistry, and beg to call the attention of the chemists of this country to that meeting, with the hope that many may be induced to attend. Those who subscribe and receive their membership cards will be entitled to all reductions in rates going to and coming from Vienna which are arranged for members of the Congress. During the Paris meeting the French line of steamers reduced its rates 33 per cent. to members of the Congress. It is hoped that an arrangement can be made with some of the steamship lines during the coming summer for a similar reduction, although the committee has not yet been informed of any arrangement of this kind.

The opportunity of meeting distinguished chemists from all parts of the world should not be lost sight of, and will doubtless be appreciated by the American members. The scientific work of the Congress will be divided into the following sections:

Section 1. General analytical chemistry and apparatus, Dr. George Vortmann, Wien, IV Schaumburgergasse 16, Chairman.

Section 2. Food, medicinal and pharmaceutical chemistry, Dr. Ernst Ludwig, Wien, XIX Bilrothstrasse 72, Chairman.

Section 3. Agricultural Chemistry, Professor E. Meissl, Wien, II Trummerstrasse 3, Chairman.

Section 4. Chemistry of the sugar industry, Professor Friedrich Strohmer, Wien, IV/2 Schönburgstrasse 6, Chairman.

Section 5. Chemistry of the fermenting industries, Professor F. Schwackhäfer, Wien, XIX Karl Ludwigstrasse 74, Chairman.

Section 6. Chemistry of wine making, Dr. L. Rosler, Wien, Physiologische Versuchsstation, Chairman.

Section 7. Inorganic chemical industries (manufacture of sulphuric acid, soda, etc.), Herr Paul Seybel, Wien, III Reissnerstrasse 50, Chairman.

Section 8. Metallurgy and explosives, Professor Franz Kupelwieser, Wien, I Franzenring, Chairman.

Section 9. Organic chemical industries, Dr. Hugo Ritter von Perger, Wien, IV Gusshausstrasse 23, Chairman.

Section 10. Chemistry of the graphic industries (photo-chemistry, photography, etc.), Dr. Josef Maria Eder, Wien, VII West Cohnstrasse 25, Chairman.

Section 11. Didactic chemistry, Professor Franz Lafar, Wien, Technische Hochschule, Chairman.

Section 12. Electro-chemistry, Dr. Karl Kellner, Hallein, Salsburg, Chairman.

All persons desiring to become members, and wishing further information on the subject of the Congress can secure copies of the provisional 'reglement' by addressing the chairman of the committee, Washington, D. C.

Excursions, visits to localities of interest, banquets, etc., will be arranged for and definitely announced at a later period. Papers in German, French and English will be accepted, and authors are requested to communicate with the several chairmen and send them titles of papers and subjects which they would like to have discussed.

All persons intending to become members of the Congress may receive a membership card from the Secretary, Dr. F. Strohmer, by sending 21 francs to his address, IV/2 Schönburgstrasse, Nr. 6, Vienna, Austria. If preferred, members may send $4.30 to the Chairman of the American Committee, who will transmit the proper amount to Dr. Strohmer.

The provisional officers of the Congress are as follows:

President of Honor—Hofrath Professor Dr. Alexander Bauer.

Active President—Regierungsrath Dr. Hugo Ritter v. Perger, Professor in the Royal Imperia Technical High School of Vienna.

Vice-President — Regierungsrath Dr. Josef Maria Eder, Director of the Royal Imperial Graphic School in Vienna.

Secretary—Professor Dr. F. Strohmer, Director of the Experiment Station for Beet Sugar Industry, Vienna.

Respectfully,

H. W. WILEY, Department of Agriculture, Washington, D. C., *Chairman.*

W. O. ATWATER, Middletown, Conn.

PETER T. AUSTEN, 11 Broadway, New York, N. Y.

C. F. CHANDLER, Columbia University, New York, N. Y.

B. F. DAVENPORT, 161 Tremont street, Boston, Mass.

C. A. DOREMUS, 17 Lexington avenue, New York, N. Y.

C. B. DUDLEY, Altoona, Pa.

W. L. DUDLEY, Nashville, Tenn.

WM. P. MASON, Rensselaer Polytechnic Institute, Troy, N. Y.

WM. MCMURTRIE, 100 William street, New York, N. Y.

C. E. MUNROE, Columbian University, Washington, D. C.

A. A. NOYES, Massachusetts Institute Technology, Boston, Mass.

T. B. OSBORNE, New Haven, Conn.

IRA REMSEN, Johns Hopkins University, Baltimore, Md.

W. B. RISING, Berkeley, Cal.

EDGAR F. SMITH, University of Pennsylvania, Philadelphia, Pa.

F. G. WIECHMANN, 771 West End avenue, New York, N. Y.

FRANCIS WYATT, 39 South William street, New York, N. Y.

PROPOSED SYLVESTER MEMORIAL.

TO THE EDITOR OF SCIENCE:—May I be permitted to appeal through your columns to all friends and admirers of the late Professor J. J. Sylvester to assist in founding a suitable memorial in honor of his name and for the encouragement of mathematical science. A movement was inaugurated on this side of the Atlantic soon after his death, and it was resolved by the promoters that a fund should be raised for the purpose of establishing a Sylvester Medal, to be awarded at certain intervals for mathematical research to any worker irrespective of nationality. For the purpose of carrying out the scheme, a strongly representative International Committee has been formed, and I should like to take advantage of this opportunity of expressing the great satisfaction which it has given to the promoters to be enabled to include in this Committee so many great and distinguished names from the American universities. In every case our invitation to join the Committee has been most cordially responded to, and the consent has in many instances been accompanied by expressions of the greatest sympathy and encouragement. The list as it stands practically includes the leading mathematicians of the whole world.

It has been estimated that a capital sum of $5,000 will be sufficient for the proposed endowment, and of this about one-half has already been subscribed here. In appealing to the American public to enable us to complete the desired sum I am in the first place prompted by the consideration that Sylvester's association with the Johns Hopkins University and the leading part which he took in advancing mathematical science in America renders his claim to estimation on the part of the citizens of your country quite a special one. It is but a modest endowment that we are asking for, and I am sure that all those who were personally acquainted with him and who realize the great influence which he exerted in raising the intellectual level of every institution with which he was associated will be glad of this opportunity of coöperating in the movement.

It is proposed that the fund when complete shall be transferred to the Council of the Royal Society of London, that body having undertaken to accept the trust and to award the medal triennially to mathematicians of all countries. I can hardly venture to trespass upon your courtesy to the extent of asking you to print the complete list of our Committee, but for your own information I beg to send a copy herewith. It will be sufficient to state that it comprises the names of President Gilman, of the Johns Hopkins University; of Professor Simon Newcomb, of Washington; of Professor Willard Gibbs, of Yale; of Professor Pierce,

Harvard, and many other well known American men of science. Subscriptions may be sent to and will be acknowledged by Dr. Cyrus Adler, the Smithsonian Institution, Washington, or by Dr. George Bruce Halsted, President of the Texas Academy of Science, 2407 Guadalupe street, Austin, Texas.

RAPHAEL MELDOLA,
Hon. Organizing Secretary.
TECHNICAL COLLEGE, LONDON, ENGLAND,
December, 1897.

TRAVEL AND TRANSPORTATION.

TO THE EDITOR OF SCIENCE: In my book on 'Travel and Transportation,' published in the *Smithsonian Report* for 1894, pages 280 and 281, will be found pictures of the only climbing device ever reported to have been used by an American Indian. At the time of describing this apparatus I had no information as to the manner of its use. During the last summer Doctor Franz Boas made a journey among the Bella Coola Indians, British Columbia, and saw the apparatus employed in climbing. It is also used by the Tlingit and other tribes as far south as Vancouver Island.

The wooden portion figured in the *Report* is not a boatswain's chair, but a foot-rest; the soft, flat portion is for use around the upper part of the back of the climber, under his arms. This combination is necessary in the Northwest country because the trees are not altogether devoid of limbs and knots; therefore, at certain points on the tree, the climber must unship his apparatus in order to pass the obstruction. My figures show that both parts of the device have loops so that the rope may be withdrawn at any time. The climber connects the upper half with the lower half of the apparatus by means of lines. When he arrives at a limb he draws his foot-board up as high as possible; then resting his body on this he readjusts the upper portion, sustaining his back above the obstruction, and moves upward as far as he can reach. Then, hanging himself in this, he is able to draw up and readjust his foot-board and make fast again after the manner of the inch worm.

The specific difference between this device and any other with which the writer is acquainted is in this facility of readjustment on account of knots and limbs by means of the connecting lines between the upper and lower half of the apparatus as explained by Doctor Boas.

O. T. MASON.

'TIME WASTED.'

TO THE EDITOR OF SCIENCE: Apropos the article in your last issue 'Time Wasted,' a professor in a reputable theological seminary in the West lately informed me that the astronomers were now convinced the end of the world was imminent. To substantiate his statement he showed me an article in a religious paper, *The Prophetic News and Israel's Watchman*, where such a prediction was made on the strength of some utterances from "Professor S. J. Carrigan, Director of the Carleton University, Northfield, Minnesota, the great university of the Northwest of America." Professor Carrigan is spoken of as having written an article in '*Popular Astronomy*, the recognized organ of American astronomy' on the subject, and he is said to have 'discovered the existence of three hitherto unknown planets, which are *tearing through space* between our earth and the sun.' The following extracts are then made from his article: "This new planet (one in the process of evolution from the sun) may at any instant break away from the sun, and the terrific explosion which will necessarily accompany this breaking away will produce a great disturbance of the entire universe, but particularly of the earth, perhaps completely smashing it, and surely destroying all animal life on land as well as in the waters." "Neither is this tremendous disturbance of the earth and *the destruction of all life* upon it completely unprecedented. A similar detachment of solar matter by the same means is known by the scientists to have occurred twenty-three million years ago, a period simultaneous with the Paleozoic age, at which time all animal and vegetable life then existing on the face of the earth was crushed out." "The results of my investigations on this subject indicate that the earth is closely approaching a critical epoch. These results convince me that it is imminent."

An account of the etiology of these peculiar products of journalism would be of interest.

X.

ZOOLOGY AT THE UNIVERSITY OF CHICAGO.

TO THE EDITOR OF SCIENCE: My attention has just been called to the following statement in SCIENCE, No. 157, p. 993:

"The student of science may fairly ask whether, when twelve doctorates are conferred in zoology and but three in Latin and Greek combined, this means that there is less demand for teachers of the classics or that a less exacting preparation is required."

Such is the comment appended to a mere summary of the Ph.D. degrees conferred by the University of Chicago during its first five years.

I am surprised to see insinuations of this kind obtruded as 'University News.' Neither 'a student of science' nor a student of anything worth naming could 'fairly' indulge in such ambiguous reflections on the basis of figures which he does not understand, and while pretending merely to report 'University News.' Moreover, it seems difficult to assign a proper motive for the remark under any circumstances. Had the reporter, who poses as 'a student of science,' even a reading knowledge of zoology, he would have seen the impertinence of his query. Our zoological theses already published would be sufficient, I think, to 'fairly' satisfy any one qualified to understand them whether the 'preparation' here demanded is adequately 'exacting.' Graduate students from colleges and universities in good standing, who devote from three to five years to their theses, are entitled to be judged by the merits of their work, and are not 'fairly' open to disparaging conjectures on the part of uninformed reporters of university news.

If comments were in order in such a report, I should have supposed that the result of 'five years of graduate work' might have suggested something more appropriate than an invidious comparison between zoology and the classics.

What excuse for saying 'but *three* in Latin and Greek combined,' when Latin is not represented in the 'three' at all? The author thus insidiously seeks to give point to the suspicion which he casts in his query, realizing that the contrast between zoology and Greek alone was not quite excuse enough for his remark. To one desiring to represent things 'fairly,' what could be more obvious than that no such query was permissible on the figures recorded for the first five years of the University's existence, when the different departments could not be supposed to be equally advanced in organization or to have begun work under equal conditions? What justice could there be, for example, in comparing the 3 in Greek with the 0 in Latin? Would 'a student of science' need to be told that no inference could be drawn from the bare numbers 3 and 0 in this case as to the standards of work upheld by the two departments? And what more senseless than to ask if the 0 indicates 'a less demand for teachers' or 'a less exacting preparation?'

It so happens that zoology has conferred eleven doctorates (the report of twelve is incorrect), nearly double the number in any other department. We are not ashamed of any of them, nor afraid of any just comparison. And while we take due pride in every one of them, it would be nothing less than contemptible to disparage any other department with a smaller record. There is reason for our larger number, but very remote from the suggestion so gratuitously offered by the reporter for SCIENCE. When we came to Chicago we brought with us five candidates for the Ph.D in zoology, some of whom had already spent three years on their research work while in Clark University. Our number for the five years in Chicago is thus to be considerably reduced for comparison with that of any other department. Other circumstances, which we need not here explain, would readily account for whatever differences remain.

If enough has not been said to show the absurdity of the comparison made in SCIENCE, and the injustice of disparaging comments based upon obviously insufficient data, then there is but one thing for this 'student of science' to do, and that is, to drop his study of science for the more humble occupation of learning some of the elements of common sense.

C. O. WHITMAN.

UNIVERSITY OF CHICAGO,
January 8, 1898.

[PROFESSOR WHITMAN rebukes the writer of the note in SCIENCE for lack of common sense by precept, but not by example. The sentence

complained of is as follows: "The student of science may fairly ask whether, when twelve doctorates are conferred in zoology and but three in Latin and Greek combined, this means that there is less demand for teachers of the classics or that a less exacting preparation is required." It seems difficult to interpret this in any other way than to the effect that if fewer doctorates are conferred in the classics than in the sciences then it follows that there are fewer adequately prepared teachers of the classics than of the sciences. We should not like to publish an unsigned note disparaging the classics—least of all the admirable instruction given in the classical languages at the University of Chicago—but it is proper for a scientific journal to call attention to the fact that more well-trained teachers and students have been sent out from the University of Chicago in zoology than in any other subject.—ED. SCIENCE.]

INFORMATION DESIRED.

I shall be greatly indebted to any reader of SCIENCE who will inform me of the whereabouts of a partial cranium of *Bison antiquus*, figured in the *Kansas University Quarterly* for July, 1897, and stated to be 'in a high school in Illinois.'

F. A. LUCAS.

WASHINGTON, D. C.

SCIENTIFIC LITERATURE.

A Text-Book of General Lichenology, with descriptions and figures of the genera occurring in the northeastern United States. By ALBERT SCHNEIDER, M.S., M.D., Fellow in Botany, Columbia University, 1894–1896. Binghamton, N. Y., Willard N. Clute & Company. 1897. 8vo. Pp. xvii+230. Pl. 76.

It is now several months since this important work first appeared, and doubtless many American botanists are already familiar with its contents. The author intended it primarily as a text-book for the use of students in colleges and universities, and it is not too much to say that, with all its faults, it is the only modern work of its kind in the English language. The first chapter is devoted to the history of lichenology, in which seven periods are recognized, viz.: I. Theophrastus (circa 300 B. C.) to Tournefort (A. D. 1694). II. Tournefort to Micheli (1729). III. Micheli to Weber (1779). IV. Weber to Wallroth and Meyer (1825). V. Wallroth and Meyer to Schwendener (1868). VI. Schwendener to Reinke (1894). VII. Reinke to the close of 1896. This historical summary will be of interest to students, especially those who do not have access to the older works, which are conveniently cited in numerous footnotes. In this historical treatment the author has quite needlessly separated the last three years, a procedure due to his adherence to Reinke's somewhat confusing views as to the nature of lichens.

The second chapter deals with the subject of Symbiosis, including (*a*) antagonistic and (*b*) mutualistic symbiosis, the latter only, according to our author, occurring in lichens. This view, again, is inspired by Reinke.

The third, fourth and fifth chapters are devoted to the structure, growth and reproduction of lichens. To our mind this is the best part of the book, and the student who goes over these chapters carefully, while studying the plants themselves in the laboratory, will obtain a very good idea of the subject they treat, especially if, at the same time, he makes use of the text and plates of Part II., dealing with classification and special morphology. Regarding the latter it may be said that the text is far better than the plates for the purpose for which the book was prepared. The figures are almost entirely diagrammatic, in spite of the statement on page 110 that they were 'made from hand sections mounted in water (C. ocular, 1-5 objective, and camera lucida).' The student who is led to suppose that he may obtain sections like these will find himself sadly mistaken after making the attempt. As diagrams these figures will be helpful, but they should not be placed before the student as camera lucida drawings of actual sections. The text of this portion of the book possesses the merit of clear and direct statement, which is more than can be said of lichen litera-

ture in general. Whether it will prove to be full enough and sufficiently accurate to be quite helpful we are not able to say, not having as yet had the opportunity of giving it a prolonged trial in the laboratory, but a somewhat careful examination of the pages pertaining to a few of the familiar genera has impressed us favorably.

The chapter on phylogeny brings out the author's views as to the nature of lichens, views which, as stated above, are essentially those of Reinke. He holds with the Schwendenerians that the fungal symbionts of the Ascolichens are derived from the Ascomycetes, and these represent different groups of fungi, *e. g.*, Pezizaceæ, Patellariaceæ, Phacidiaceæ, Stictidaceæ, Sphæriaceæ. With Schwendener also, he refers the 'gonidia' to various algal types. By returning to the second chapter we learn that the relation between fungi and algæ is considered to be the highest form of mutualistic symbiosis, which he terms individualism. This requires "that one of the symbionts be absolutely dependent upon the mutual relationship." In lichens, our author says: "We find the nutritive interdependence so marked that a new individual is formed, which in its morphology and physiology is wholly different from any of the symbionts." Again: "From the very nature of individualism it is evident that the resulting structure is a morphological unit in the full sense of the word—that is, a lichen is neither a fungus nor an alga, but a new individual which should be given a definite position in the vegetable kingdom. It is an independent individual, because we find that on separating the symbionts the individual is destroyed, as has already been indicated." We have thus a new kind of taxonomic unit, consisting of two organisms—(*a*) that derived from fungal ancestors, and (*b*) that derived from algal ancestors. This dual thing is the lichen. Hence, lichens, being entirely unlike anything else under the sun, are to be regarded as constituting a distinct class! We have thus a nominal restoration of the Class Lichenes, for which the lichenologists have been fighting for a quarter of a century. But what a restoration! A lichen is no longer a single organism, comparable to a Fucus, a Polysiphonia or a Marchantia, but a compound of two organisms, and these admitted to be of fungal and algal origin. When it comes to this, the autonomists might as well surrender and come at once into the Schwendenerian camp.

It but remains for us to say that this book, with all its shortcomings, will be useful, and that the publishers have done well in their selection of type and paper, and have furthermore given it a substantial binding.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

Organic Chemistry for the Laboratory. By W. A. NOYES, PH.D. Easton, Pa., Chemical Publishing Co. 1897. 12mo. Pp. xi+257. Price, $1.50.

Two purposes have been kept in view by the author in writing a new book on organic preparations. "The first has been to furnish the beginner with sufficiently full and accurate directions, and clear, concise, theoretical explanations of processes which have been found successful in practical laboratory experience. The second object has been to furnish the more advanced student and practical worker with a guide which will aid him in the selection of processes which are likely to be successful for the preparation of compounds which he may desire to use." The book is divided into eleven chapters, in which is described the preparation of the various classes of organic compounds, namely: Acids; derivatives of acids; halogen compounds; nitro compounds; amines; hydrazo, azo, and diazo compounds, etc.; alcohols and phenols; aldehydes, ketones and their derivatives; sulphonic acids and sulphine compounds; hydrocarbons, and miscellaneous compounds. At the beginning of each chapter is a discussion of the chemical reactions involved in the different methods of preparation. This is followed by directions for the preparation of a compound illustrating each method. For example, in the first chapter twelve pages are given up to a general discussion of acids and nineteen preparations are described. In all cases the theoretical explanations and experimental details are clear and full. A particularly valuable chapter is devoted to the qualitative identification of organic compounds. The usual tests

for elements other than carbon are described, and then an account is given of the typical reactions of the classes of organic compounds (hydrocarbons, phenols, amines, etc.). By means of a melting-point or boiling-point determination, a qualitative ultimate analysis, and the application of the reactions described, a large number of compounds can be easily identified.

The descriptions of such important laboratory operations as crystallization, distillation, etc., are but meagre and are scattered throughout the book. Most of them are described in the first chapter, which treats of the preparation of acids. As the student will make scarcely more than two or three of these compounds, and probably not at the beginning of the work, he is compelled to refer to the index and search out, from the details of one or more experiments, the description of the process which he wishes to use. Filtration is discussed, for example, on pages 21, 29 and 57; crystallization on pages 27 and 54, and distillation on pages 13–15, 19, 46 and 48. The book will be particularly valuable to the advanced worker in organic chemistry on account of its logical and thorough treatment of the subject, the numerous references to the literature, and the fact that it includes the recent work of importance.

James F. Norris.

SOCIETIES AND ACADEMIES.

THE ALABAMA INDUSTRIAL AND SCIENTIFIC SOCIETY.

The regular winter meeting of this Society was held in the city of Birmingham, on the 21st of December, Truman H. Aldrich, President, in the chair.

W. M. Brewer, of the Committee on Statistics, reported that he had collected and had published, in the technical journals of the country, monthly during the present year, the statistics of coal, coke, iron-ore, limestone and other mineral productions of the State. By the end of the first week in January he expected to have ready for publication, in the Proceedings of the Society, the complete mineral statistics for the year 1897.

With reference to the approaching Exposition at Omaha it was the sense of the Society that the State of Alabama should be represented there by a full and well arranged exhibit of its mineral and other natural resources. Four new members were elected, and a committee, consisting of Mr. James Bowron, Mr. J. H. Fitts and Dr. Wm. B. Phillips, was appointed to represent the Society at the River and Harbor Convention, which is to be held in in the city of Tuscalloosa on the 29th of December. To this committee the President of the Society was added.

M. Henri Cardoza, a Commissioner of the French Government to investigate the labor conditions of this country, was presented to the Society by Dr. Phillips, and made some remarks explanatory of his mission.

Mr. Mason H. Sherman then read a paper, prepared by Wm. Blauvelt, on 'The Semet-Solvay Coke Oven and its Products.' This paper gave a very full account of the retort oven plant which is now in course of construction at Ensley, near Birmingham, and which is the sixth installation of by-product ovens in this country. The coke, tar, ammonia, gas and other by-products of these ovens were treated in detail by Mr. Blauvelt. As usual, this subject gave rise to an animated discussion, in which Dr. Phillips, Mr. Aldrich and others took part. Inasmuch as recovery-ovens and by-product plants have occupied a very prominent place in the papers read before this Society and in the discussions thereon during the past six years, it is believed that the installation of the plant at Ensley is the direct outcome of the persistent efforts of this Society to put a stop to the appalling waste incident to the use of the old bee-hive ovens.

Dr. Phillips then read a paper on 'Some of the Results of Washing the Alabama Coals for Coking,' in which he presented a number of tests carried out by him upon the cokes from the different coals mined near Birmingham, and coked under different conditions. This paper is from advance sheets of a new edition of 'Iron Making in Alabama,' by Dr. Phillips, soon to be published as a Bulletin of the Geological Survey.

President Aldrich then spoke of the great quantity of low-grade, free-milling gold ores

occurring in the eastern part of the State, and suggested that they offer a promising field to our mining engineers for experiments in concentrating on a large scale so as to avoid the necessity of running so much barren material through the mills.

The Society then adjourned to meet again in February.

EUGENE A. SMITH,
Secretary.

THE 269TH MEETING OF THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON, TUESDAY, DECEMBER 21.

MR. GEO. R. STETSON, in his paper upon 'The Climacteric of the Negro Problem,' discussed the causes which have brought about the estrangement of the races; contending that race discrimination upon the part of the whites is frequently justified by necessity; a practice of which the negro cannot justly complain, as in every instance where he has obtained governmental control—in the West Indies, in Liberia and elsewhere—white citizenship is absolutely proscribed.

The progress in the economic condition of the negro is without intention sentimentally exaggerated; while numbering 12 per cent. of the population, the value of his taxable property is but 0.39 of one per cent. of our total wealth. The negro does not suffer from the lack of opportunity, but for want of the means and knowledge to make the opportunity his own. While his criminal record is bad, if we take into consideration his opportunities and moral status, our own record of degeneracy is worse, and the White Problem is quite as serious as the Negro Problem.

Mr. Stetson attributed the present climacteric to the default on our part, and especially of those more closely associated with him, in ignoring the ethical relations of the two races and neglecting personal interest in the negro's moral, industrial and general training. "Our chief and fatal error lies in not practically reorganizing in our educational systems his peculiar racial needs and differences;" an error which has been fatal to his social progress, and highly inimical and dangerous to the collective interests of both races.

The primary and greatest need of the negro and forty-one per cent. of our white population is practical instruction in agriculture in the elementary school, a system already revived in France, Germany, Russia and Ireland.

The abandonment of secondary education at the public expense was advocated upon the ground of its inaccessibility to the great majority of both races, and especially to the negro, the effect of such education upon races of inferior development and upon inferior classes of the higher races being to create a prejudice against manual labor. Incidentally, Mr. Stetson advocated positive religious instruction in the elementary school, and the establishment of the kindergarten as a necessary reënforcement of our school systems in the presence of an environment seething with the most virulent moral pest germs.

Mr. O. F. Cook, professor of natural science in Liberia College, Monrovia, read a paper on 'Traits of Native African Character,' in which he described the negro as he exists to-day in this negro republic, and gave the difference in character between them and those of the United States. His remarks showed a close and true study of these people, and how they had succeeded, notwithstanding the current belief in this country to the contrary. In Liberia and among the native population generally they respected the judgment and ability of the white man.

J. H. MCCORMICK,
General Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the meeting of December 22, 1897, Mr. W. Lingdren, of the United States Geological Survey, read a paper on 'The Canyons of the Salmon and Snake Rivers, Idaho.' The little known region between Idaho and Oregon where the Snake River and its mighty tributary, the Salmon, join is one of exceptional interest. In this vicinity lies the eastern margin of the great Columbia lava-fields, the shore line, so to speak, where the moulten flows were arrested by the mountain ranges of Idaho. Near Weiser, Snake River leaves the broad open valley occupying such a large part of southern Idaho, turns northward and flows across the great lava

masses in a canyon which in grandeur is only second to the Canyon of the Colorado. It is an abrupt trench cut to a depth of over 5,000 feet in the basaltic plateau. The deepest and most impressive part lies in the vicinity of the Seven Devils, a group of peaks rising to elevations exceeding 9,000 feet on the eastern side of the river. From the summits of these there is a sharp and continuous slope of 8,000 feet down to the level of the river. The exposures along the canyons are magnificent, showing from 1,000 to 4,000 feet of horizontal lavas covering a series of older slates and greenstones.

The Salmon River Canyon, for a long distance above its junction with the Snake, is between 4,000 and 5,000 feet deep. Except in its lowest portion, it is cut in the rocks of the older series. Granitic rocks, forming a large part of the great Idaho granite area, occupy a large space in Idaho adjacent to the Columbia lava. Instead of being of Archean age, as has been hitherto supposed, the granite is probably post-Carboniferous, as shown by the contact metamorphism of the Paleozonic series adjoining on the north.

This series of slates, limestone, schist and greenstones present the greatest similarity to the Auriferous slates of the Sierra Nevada. Round Crinoid stems were found in one of the limestone lenses. Excellent exposures are found in the lower Salmon River Canyon and along the Snake River. The Columbia lava flows are of Miocene age. They consist nearly exclusively of massive basalt, and are piled up one on another in seemingly endless succession. Slight differences of structure make the individual flows conspicuous and from a distance the exposures along the canyon side appear like those of a sedimentary series. The lava flows were poured out over an exceedingly uneven surface of deep valleys and precipitous mountain ranges. The latter tower far above the summit of the lava plateau, while the bottom of the former lie below the level of the river. Coupling this evidence with the fact that the sediments in the lower Snake River Valley, above Weiser, are of great depth, their bottom probably not being far from sea level, it appears that this whole area has suffered a depression since pre-volcanic times. The great outpouring of the Columbia lava evidently dammed a gap between the two high pre-volcanic ranges, the Blue Mountains of Oregon on the west and the Salmon River Ranges on the east. This barrier produced a great lake, the Miocene and Pliocene sediments of which now fill the upper Snake River Valley. The inland sea overflowed its barrier, established an outlet and the mighty volume of water has worn a canyon which eventually drained the lake.

At this meeting the Society elected officers for the ensuing year. These are: President, Arnold Hague: Vice-Presidents, Joseph S. Diller and Whitman Cross; Treasurer, M. R. Campbell; Secretaries, C. Willard Hayes and T. W. Stanton; Members-at-Large of Council, S. F. Emmons, George P. Merrill, W. H. Weed, David White and Bailey Willis.

W. F. Morsell.

U. S. Geological Survey.

NEW BOOKS.

The Smithsonian Institution, 1846–1896. The History of its first half century. Edited by George Brown Goode. City of Washington. 1896. Pp. 856.

Audubon and his Journals. Maria Audubon. With zoological and other notes by Elliott Coues. New York, Charles Scribner's Sons. 1897. Vol. I., pp. x + 532. Vol. II., viii + 535. $7.50.

Revision of the Orthopteran Group Melanopli (acridiidæ). With special reference to North American Forms. Samuel Hubbard Scudder. Washington, Government Printing Office. 1897. Pp. 421. 26 plates.

An Elementary Course of Infinitesimal Calculus. Horace Lamb. Cambridge, The University Press; New York, The Macmillan Company. 1897. Pp. xx + 616. $3.00.

Theoretical Mechanics. A. E. H. Love. Cambridge, The University Press; New York, The Macmillan Company. 1897. Pp. xiv + 370. $3.00.

Lessons With Plants. L. H. Bailey. New York and London; The Macmillan Company. 1898. Pp. xxxi + 491. $1.10.

SCIENCE

FRIDAY, JANUARY 21, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

GEORGE H. HORN.

GEORGE HENRY HORN was born in Philadelphia, April 7, 1840, and died at Beesley's Point, N. J., November 24, 1897. He was stricken with apoplexy in December, 1896, resulting in hemiplegia, and thereafter passed most of the time, until his death, at or near the seashore.

Dr. Horn received his preliminary education in the Jefferson Boys' Grammar School, and from this entered the Central High School of Philadelphia, July, 1853. He graduated February 11, 1858, with the degree of Bachelor of Arts, and received his Master's degree from the same institution in July, 1863. He entered the University of Pennsylvania as a medical student soon after receiving his first degree from the High School, and received the degree of M. D. in 1861, his graduating thesis being on 'Sprains.'

The patriotic young physician enlisted in the U. S. Army in 1863 and received a commission as Assistant Surgeon, March 1st, of that year. He was first attached to the Second California Cavalry, Department of Pacific, until July 14th of the following year, then commissioned as Surgeon to the First California Infantry Volunteers, retaining this position until the term of service of this regiment expired, December 3, 1864. He was again mustered into service May 22, 1865, as Assistant Surgeon of his old regiment, the Second California Cavalry,

and was commissioned as Surgeon of the Second California Infantry, September 23, 1865. His services terminated with that of the staff of his regiment, April 16, 1866.

In the course of his service he spent some time in California, Arizona and New Mexico, in territory which was at that time almost unknown to collectors or students of Coleoptera, or, indeed, any order of insects. From the beginning Dr. Horn had been interested in natural history, and his tastes in this direction had been encouraged and stimulated by some of his teachers in the High School. The opportunity given by his service in these unknown territories was not neglected, and large collections of insects, principally Coleoptera, were made. In the course of his collecting he met with many ludicrous and some dangerous experiences; but he gradually interested many of the soldiers in his work, and some of the rarities in his collection were taken, according to his statements, by privates who picked them up and brought them to him. This was the most extensive field experience gained by the doctor, and throughout his life he was always much more interested in the fauna of this particular territory than in that of any other. His familiarity with the region and the peculiar difficulties of collecting in it led him to attach unusual interest and value to specimens originating there, and, as a result, his collection was most complete for this particular fauna. Dr. Horn was naturally an original student, and began his work in Entomology in 1860, even before graduating from the Medical School. Yet his first paper was on Molluscs, not insects, though his first descriptions of new Coleoptera appeared only a few months later.

On his return to Philadelphia he established himself as a physician, with an office at the then residence of his father, at the corner of Fourth and Poplar streets, and this office he retained until his death, although for some time previously he had not been practicing. When he began work his father, Mr. Philip Horn, carried on business as a druggist, and back of the store the doctor had a little room for consultations. This also he retained long after the drug business had passed out of his father's hands.

The neighborhood in which the doctor settled was a populous one, and he soon began to make a specialty of the diseases of women and children, gradually acquiring a large obstetrical practice, and being often called in consultation in difficult or unusual cases.

Dr. Horn never married, and much of his time, when not actually engaged in the outside business of his profession, was passed in a large room on the second floor, in which he had an iron bedstead, two or three chairs, a huge desk, a small table or two, and shelves and cabinets wherever there was room to place them. The desk, except for a small space near the middle of one side, was always piled with books, papers and specimens in boxes of all kinds. The chairs were piled with material of the same character; the shelves and cabinets were filled to overflowing. When a visitor arrived whose entomological taste entitled him to admission to this apartment he either sat on the bed, or a chair was cleared for his accommodation. Not unusually, the bed was more or less filled with books and papers, and everything was always in such condition that scientific work could be resumed at a moment's notice whenever the doctor came in from a round of calls or had a few moments to spare during office hours. A physician in active practice does not have much time during the day, and in the special line in which Dr. Horn was engaged night calls are not infrequent; so that his hours of sleep were frequently more or less irregular and always scant. When no calls took him away he would work until midnight or long afterwards, over his collections. Almost

as a necessary consequence of the constant readiness of his room for work, it was forbidden to do any cleaning, except in the immediate vicinity of the bed. During the entire time that I was acquainted with Dr. Horn—and this was nearly eighteen years—I can remember no more than one occasion when the room had been actually swept and scrubbed in its entirety. When Dr. Horn began to give up active practice, several years ago, he ceased to sleep in this room, and it was not long before the bed was piled as high as the table with books, boxes and other literary or entomological material.

For many years Dr. Horn seemed to have no interest in life outside of his profession and his scientific work in Celeoptera. His collections in this order increased enormously, as did his knowledge ; so that, even during the lifetime of Dr. Leconte, he was the man best acquainted with the structural characteristics of the North American Coleoptera.

It is almost impossible to speak of Dr. Horn without also referring to Dr. John L. Leconte, his fellow townsman, and for many years also his fellow worker in Coleoptera. Although at first there was some friction between him and the younger man, who was very positive in many cases where the older, more experienced student was inclined to be conservative, yet the two men soon became firm friends, and so continued during their joint lives. The combination was useful to both. Dr. Leconte was, by all odds, the broader man ; his knowledge of nature at large was much wider, and he saw his specialty, the Coleoptera, much more truly in their relation to the other orders of insects, and this class in its relation to the rest of the animal kingdom. Dr. Horn was much more completely a specialist, with little interest outside of the Coleoptera, but in this knowledge of detail was infinitely greater, and the result of combining two such men appears in the Classification of the North American Coleoptera, which is their joint production. There is no other work which will compare with this in the amount of condensed strictly scientific, technical information on this order of insects. Unfortunately, these characters, which render it so valuable to the advanced student, rather repel than attract the tyro.

Dr. Horn was by nature an arranger of things. In his hands the most hopelessly mixed lot of specimens separated themselves naturally ; he found characters where none had been suspected, and his appreciation of the value of apparently immaterial or insignificant structures resulted in some of the most brilliant work that he did. He had an almost intuitive perception, which enabled him to arrange a large mass of species in a natural series. He had also the power of persistent and practical application, the ability to do continuous hard work, which enabled him to give a solid scientific foundation to the conclusions that he had reached. He had a facile pencil, which he used in illustrating his work. His pictures were by no means artistic, for that faculty was to a great extent lacking ; but somehow his drawings, even when they were mere outlines, seemed to convey the information that he intended they should, so that his sketches were always a real help.

It is difficult for one who is not a specialist to appreciate the work that was accomplished by Dr. Horn. The number of titles of papers published by him is not especially large. It does not exceed 240, all but six entomological, and in these about one hundred and fifty new genera and about fifteen hundred and fifty new species were described. But this does not fairly express the work that was accomplished, because, by all odds, the greater part of Dr. Horn's species and genera were described in connection with monographic work, so that while a paper might contain descriptions

of only one new genus or only a few new species it would yet contain descriptions of all the genera and all the species of a large group. He wrote few short papers and, as he never was an editor, was not compelled to supply 'fillers.' He believed in monographic work covering considerable groups, or at least a large genus, and rarely wrote critical or review notes. He was by no means a diffuse writer, and his papers are models of brevity, and of clear, succinct statement. His descriptions of species and genera have never been excelled, and one is rarely left in doubt as to which species the doctor had before him when writing. His monographic and revisional papers are almost all built with the evolutionary idea constantly in mind. The preliminary divisions are always made upon well defined structural characters, and around each type of structure its derivatives are grouped. His belief was that species are not isolated facts or productions, but that they are parts of a great scheme, which it is the work of the systematist to unravel. Species are the products of their surroundings, and each species consists of an aggregation of individuals. No one specimen, to his mind, ever could represent a species. It required at least a male and a female, and a proper definition of a species is one that would include also all the variations of both sexes; therefore, Dr. Horn never had a 'type' specimen, because he did not admit that any individual could be a type of a species. The species consists of a certain combination of characters; all the individuals containing this combination of characters are equally types of the species; therefore, there was not anywhere in his collections any individual marked as a type of any species described by him. In fact, Dr. Horn never considered the individual; to him it was simply an evidence of the existence of a certain combination of structures, and no more. A well-known Coleopterist has compared Dr. Horn's description of species to an excellent portrait whose likeness to the original is so great as to be recognizable at the first glance.

While the most of the work done by Dr. Horn referred to the North American fauna, he was yet well acquainted with the general character of the Coleopterous fauna of the world at large, and in his most notable papers he considered our own species and genera in comparison with those of other countries. The two papers which effectually fixed his place in the first rank of workers in entomology were his 'Genera of Carabidæ,' published in 1881, and his paper on 'The Silphidæ,' printed in 1880. The first cited was the most brilliant of the two; the second required much the more painstaking labor. Both of these have been accepted by all students of this order.

Dr. Horn's influence upon Colepterological work in North America has been so great that almost all the present students are following his methods wherever they are doing similar work. He was a 'closet naturalist,' a worker with dry specimens; he never dealt with microtomes or sections, and considered life histories of subordinate importance, though necessary to a complete understanding of the insects in all cases. Nevertheless, his work will always stand as a contribution to knowledge, because it is original, accurate, and, with a vital meaning so far as it goes. It will stand the test of time and of critical examination in the future, for it is well done.

His rank and standing were recognized in foreign countries, some of which he visited several times to familiarize himself with their best collections, as well as in America. He was an honorary member of the Societié Entomologique de Belgique, of the Societé Entomologique de France, and of the Entomologischer Verein in Stettin; an active member of the Societas Entomo-

logica Rossica, and a corresponding member of most of the other foreign societies as well as of the k. k. Zoölogische-Botanische Gesellschaft in Wien. He was an honorary member of most of the American entomological societies, and a corresponding member of many other natural history societies throughout the country.

From an early date he was connected with the Academy of Natural Sciences in Philadelphia, where he held the office of Corresponding Secretary for fourteen years, and was a member of Council and of the Finance and Publication Committees for long periods of time. He was also a prominent member of the American Philosophical Society, in which he was Secretary and Librarian at the time of his death. In the American Entomological Society he was always a leading member, succeeding Dr. Leconte as President in 1883, and he was also Director of the Entomological Section of the Academy of Natural Sciences. In 1889 he was appointed professor of entomology at the University of Pennsylvania; but the position was a purely honorary one, and he did not teach or lecture.

Personally he was a good friend and a genial companion. While not in any sense a 'social' man, he could at times relax completely and act as though no such science as entomology existed. It is more than probable that his intense and continuous application and the nervous tension induced by it contributed to his death. That the doctor himself realized that he was doing too much is proved by the fact that for several years he had gradually reduced his active practice, and finally gave it up entirely, to spend a large portion of the summer at least at the seashore. But the mischief had been done and the final blow was only a little delayed.

Entomological science can ill afford to lose a man of his calibre!

RUTGERS COLLEGE. JOHN B. SMITH.

PRESENTATION OF PROFESSOR MARSH'S COLLECTIONS TO YALE UNIVERSITY.

AT the meeting of the Yale Corporation, held on the 13th inst., O. C. Marsh, Professor of Paleontology, formally presented to the University the valuable scientific collections belonging to him, now deposited in the Peabody Museum. These collections, six in number, are in many respects the most extensive and valuable of any in this country, and have been brought together by Professor Marsh at great labor and expense, during the last thirty years. The paleontological collections are well known, and were mainly secured by Professor Marsh during his explorations in the Rocky Mountains. They include most of the type specimens he has described in his various publications. The collection of osteology and that of American archæology are also extensive and of great interest. The present value of all these collections makes this the most important gift to natural science that Yale has yet received.

At the same meeting the Yale Corporation accepted Professor Marsh's gift by a unanimous vote, and expressed their high appreciation of his generosity to the University.

Professor Marsh's letter accompanying his deed of gift is essentially as follows:

To the President and Fellows of Yale University.

GENTLEMEN: It is thirty years and more since Mr. George Peabody established at Yale, by a gift of one hundred and fifty thousand dollars, the Museum that now bears his name. This was in 1866, the year I began my work as Professor of Paleontology, and I secured this gift mainly with a view of building up a Department of Paleontology that should be a school of original research as well as one of instruction. The collections of natural history which I had thus brought together were subsequently deposited in the Peabody Museum, and from that time I have endeavored in every way to increase these collections, so that at present they are in many respects the most extensive and valuable in this country.

It has always been part of my plan that these scientific collections should eventually become the property of Yale University, and from the first I pro-

vided in my will for such a disposition of them. As it now seems probable that I may not be able to carry out my original intentions in regard to a Department of Paleontology at Yale, I have decided to present these collections to the University, subject only to certain conditions that appear necessary for their permanent care and preservation. The deed of gift, which I herewith enclose, bears the date of January 1st, 1898.

These various collections, now deposited in the Peabody Museum in New Haven, include six of special importance which may be briefly described as follows:

(1) *The Collection of Vertebrate Fossils.* This is the most important and valuable of all, as it is very extensive, contains a very large number of type specimens, many of them unique, and is widely known from the descriptions already published. In extinct Mammals, Birds and Reptiles, of North America, this series stands preëminent.

This collection was pronounced by Huxley, who examined it with care in 1876, to be surpassed by no other in the world. Darwin, in 1878, expressed a strong desire to visit America for the sole purpose of seeing this collection. Since then it has been more than doubled in size and value, and still holds first rank. The bulk of this collection has been secured in my western explorations, which have extended over a period of nearly thirty years, during which I have crossed the Rocky Mountains twenty-seven times.

(2) *The Collection of Fossil Footprints.* These specimens are mainly from the Connecticut Valley, and thus have a special local interest. They also form one of the most extensive and complete collections of the kind in this country, if not the most valuable of all.

(3) *The Collection of Invertebrate Fossils.* This includes a large number of interesting specimens from many formations and localities, both in this country and in Europe. Some of these fossils I collected myself, but the greater number were secured by purchase. Among the series of specimens especially valuable may be mentioned several thousand from the famous Mazon Creek locality in Illinois ; a very extensive collection of Crinoids from Crawfordsville, in Indiana ; the largest collection of nearly entire Trilobites yet discovered, and one of the rarest series of Silurian Sponges known, including important type specimens.

(4) *The Collection of Recent Osteology.* This is believed to be the most complete collection in this country for purposes of study. I have made special efforts for many years to secure the skeletons of rare existing vertebrates from every part of the world, particularly of Mammals, Birds and Reptiles. The collection is rich in Anthropoid Apes, the Gorillas being represented by no less than thirteen individuals, and the other genera by rare characteristic specimens.

(5) *The Collection of American Archæology and Ethnology.* This collection is the best in the country in several branches of the science, being particularly rich in Central American antiquities, several thousand specimens in number and many of them unique. Some of these I obtained myself in Central America, and among the others is the famous de Zeltner collection, rich in gold ornaments, which I secured by purchase. The specimens from Mexico are also of great interest, and the series is a representative one. It includes the well-known Skilton collection.

(6) *The Collection of Minerals.* This is a limited collection, but contains many valuable specimens, among them probably the most interesting series known of Nova Scotian Zeolites. These were mainly collected by myself, before I graduated at Yale, during six expeditions to Nova Scotia.

The three principal collections in the above series, numbered 1, 4 and 5, have practically no other representatives at Yale, and hence their importance to this institution.

Besides the six main collections named, I have several others of less value, which include fossil plants, casts of fossils, geological specimens and recent zoological material. These, also, are deposited in the Peabody Museum, and are covered by the present deed of gift.

* * * * * *

On learning of the acceptance of this gift on the part of the Corporation of Yale University, with the conditions stated in the accompanying deed, I will make the formal transfer to them of all the collections above named.

Very respectfully,

O. C. MARSH.

YALE UNIVERSITY, January 1, 1898.

The conditions on which Professor Marsh gives his invaluable collections to Yale University, for the benefit of all departments of the University, are few in number, the more important being the following:

(1) The scientific collections I now give to Yale University shall be kept in the present Peabody Museum building or in additions thereto equally safe from fire.

(2) During my life, these collections shall remain, as now, under my supervision and control, available for my own investigation

and description, or for the work of others designated by me.

(3) At my decease, and forever after, these collections shall be under the charge of the Trustees of the Peabody Museum and their successors, and in the special custody of Curators recommended by them and appointed by the Corporation of Yale University.

(4) The type specimens and others of special importance in these collections shall not be removed from the Museum building. Less valuable specimens, however, especially duplicates, may be so removed by vote of the Trustees of the Museum.

From a scientific point of view, the value of the collections now presented to Yale is beyond price, each one containing many specimens that can never be duplicated, and already of historical interest in the annals of science.

Among the prominent features of one of these collections, that of extinct vertebrates, may be mentioned (1) the series of fossils illustrating the genealogy of the horse, as made out by Professor Marsh, and accepted by Huxley, who used it as the basis of his New York lectures; (2) the Birds with teeth, nearly two hundred individuals, described in Professor Marsh's well-known monograph 'Odontornithes;' (3) the gigantic Dinocerata, several hundred in number, Eocene mammals described in his monograph on this group; (4) the Brontotheridæ, huge Miocene mammals, some two hundred in number; (5) Pterodactyles, or flying dragons, over six hundred in number; (6) the Mosasaurs, or Cretaceous sea-serpents, represented by more than fifteen hundred individuals; (7) a large number of Dinosaurian reptiles, some of gigantic size. Besides there are various other groups of Mammals, Birds and Reptiles, most of them including unique specimens.

The resolutions of the Corporation of Yale University, accepting Professor Marsh's gift, and showing their appreciation of his services to the University, are given below:

YALE UNIVERSITY, January 13, 1898.

The President and Fellows having received a deed of gift from Professor Othniel C. Marsh, presenting to the University his very valuable collections now in the Peabody Museum, which represent the labor of many years on his part and also the expenditure of a large amount from his personal fortune, desire, as they accept the gift, to communicate to him and to place on record an expression of their grateful acknowledgment of his generosity.

In this grateful acknowledgment they are confident that all the graduates and friends of Yale will unite, when they learn of this most recent manifestation of his long-continued interest in the University, even as they already fully appreciate the unselfish devotion of his time, his talents and his energies, for more than thirty years, to the scientific researches which have given him such personal distinction and have brought such renown to the institution.

TIMOTHY DWIGHT,
President.

GEOLOGICAL SOCIETY OF AMERICA.

II.

Note on Lepidophloios Cliftonensis. SIR WILLIAM DAWSON, Montreal, Canada.

In the *Bulletin* of this Society for May, 1891, appeared a paper by the author on 'Fossils from the Carboniferous of Newfoundland,' including new species of *Lepidodendron* (*L. Murrayanium*). In connection with this species I noticed what seemed a closely allied form from New Brunswick, which I had named *L. Cliftonense.* Later studies of this species have shown me that it should should rather be placed in the allied genus *Lepidophloios.* I have so placed it in a more recent paper on the genus in the present year. It should, therefore, be named *Lepidophloios Cliftonensis,* but is one of the species of that genus nearest to *Lepidodendron,* and especially to my *L. Murrayanium* and to *L. Wortheni,* of Lesquereux, as I have already stated in the paper to which this note is an addendum and erratum.

The paper was read by the Secretary. In discussion David White referred to Sir William's long service in paleobotany, he having begun the study of fossil plants in 1843, at the same time with Ettingshausen and Geinitz.

Omphalophloios, a New Lepidodendroid Type. DAVID WHITE.

Mr. White described a Lepidodendron trunk that had been found in the Des Moines series (Lower Carboniferous), at Clinton, Mo. After a review of the forms of the common leaf-scars on Lepidodendrons and an explanation of their functions so far as understood, the peculiar features of the one in question were outlined. The paper requires cuts to make these clear. It was discussed by H. L. Fairchild.

The Mastodon in Western Ontario. H. M. AMI.

Mr. Ami described the exhuming of two mastodons in Ontario, one in Essex county, north of the west end of Lake Erie, and one in Norfolk county, at the east end of the same lake. In the former case the section of six to eight feet that was dug up involved the following from below upward, at the bottom clay and boulders; then gravel, the bones, sand and shell marl, sand and peat, gray sand, sand and ochre yellow sand. The remains were fragmentary. In Norfolk county the pit was three to four and one-half feet; at the base was clay; then shell marl, mottled sand, gray sand and peat. The skull extended from the clay through the others. In addition, 25 ribs, 40 feet-bones, 2 tusks and many vertebræ were recovered. In the peat deer-bones and arrow-heads were found.

Mastodon and Mammoth Remains found near Hudson Bay. ROBERT BELL, Ottawa, Canada.

The paper gave an account (1) of the discovery of some mastodon bones in 1877, near the junction of the Mattagomi and Missinaibi Rivers, to form the Moose River in the southern part of the basin of Hudson Bay, and described the superficial deposits in that region; and (2) of the finding of a peculiarly small mammoth's tooth on Long Island, off the Eastmain coast of Hudson Bay. It discussed the question of the specific identity of this small northern mammoth with the common species of more southern latitudes in North America.

The first mentioned specimen was discovered by an Indian, who chopped out a tooth from a skull lying in the river and then left the latter. The speaker passed the spot at high-water and could not secure the bones. The other was found on the bare rock.

Fossil-like Forms in the Sault Ste. Marie Sandstone. ROBERT BELL, Ottawa, Canada.

In the bottom of the pit which was excavated in the sandstone for the canal lock on the south side of the Sault Ste. Marie, in 1891, a bed was found covered with very distinct markings, which in some respects resemble large plant remains, but they are probably casts of desiccation cracks. The author's remarks were illustrated by photographs of four large specimens. The remains were surprisingly like fossils, but all present agreed with the speaker in their interpretation.

Syenite-porphyry Dikes in the Adirondack Region. HENRY P. CUSHING, Cleveland, O.

Recent field work in Clinton county, N. Y., has shown the existence of dikes belonging to the syenite-trachyte family of eruptive rocks, which are of different age from the bostonites described by Kemp and Marsters from the near vicinity. They are older than the Potsdam sandstone, as they have furnished pebbles to its basal conglomerate. On the other hand, the older rocks of the region were metamorphosed before their extrusion. Together with the associated diabases they show great resem-

blance to the Keweenawan eruptives of the Lake Superior region. They possess considerable petrographical interest.

Analyses which were given showed them to be rich in soda and of a composition that would lead one to infer the presence of nepheline, yet none could be detected by chemical or optical tests. The rocks attracted much interest from the petrographers present.

In discussion J. F. Kemp outlined briefly the area in the Champlain Valley in which the smaller dikes were found, stating that they practically ceased near Ticonderoga and were not known in the southwestern Adirondacks. J. P. Iddings mentioned the difficulty of giving an expressive name to the rocks and the curious position that they occupied.

Clastic Huronian Rocks of Western Ontario, and the Relation of Huronian to Laurentian. A. P. COLEMAN, Toronto, Canada.

The speaker had been led to observe and study the rocks in question while reporting on the gold districts north of Lake Superior for the Ontario government. He reviewed the work of Lawson, H. L. Smyth and others in connection with maps, and described especially the clastic rocks. The distribution of the Conchiching around dome-like areas of the Laurentian crystallines, he suggested, could be perhaps explained by dome-like upheavals or bulgings of the latter, the domes being located where the overlying burden of sediments was thinnest. It was suggested that the same explanation might be applied to mountains elsewhere.

In discussion Robert Bell reviewed the early work of the pioneer observers in the region, and differed from Professor Coleman in his interpretation. G. O. Smith stated that many contacts in the Huronian regions on the south were obscure, but that others were very plain and showed a basal conglomerate resting on the ancient granite. G. M. Dawson spoke of the importance and difficulty of discriminating between an intruded batholite and a supporting basement of older granite. A. E. Barlow briefly described the breccias, graywackes, quartzites and conglomerates on Lake Temiscaming, and insisted that Laurentian was now only a petrographical and not a time-term. In closing the discussion Dr. Coleman replied in a few words to the remarks that had been made.

The Grading of Mountain Slopes. W. M. DAVIS, Cambridge, Mass.

With the lantern Professor Davis threw on the screen a series of views of slopes in various mountain ranges and from areas of other topographic forms and brought out the idea that, unless sapping or some other undermining action is in progress, the surface reaches a slope or grade that expresses the balance established between the weathering forces and the resistance of the materials. This feature is quite pronounced and characteristic and is described by speaking of the slopes as 'graded.' The grades differ according to the materials involved, and the evenness of the 'grade' is largely a function of the time of exposure.

The Harvard Geographical Models. W. M. DAVIS, Cambridge, Mass.

The Harvard Geographical Models, designed by the author and constructed by Mr. G. C. Curtis, have been prepared for the purpose of giving systematic illustration of a number of geographical forms in their genetic relationship. Three of the series were described and exhibited by means of lantern slides. They represent a mountainous region descending to the sea; the same after depresssion, whereby the shore-line has become very irregular; the same after elevation, whereby a coastal plain has been added to the land area.

The Society then adjourned until the following day. In the evening a reception

was tendered the Fellows by Mrs. J. B. Porter and Mrs. F. D. Adams in the new McDonald mining laboratories of the University. Many of the faculty families and their friends in the city gathered to welcome the Fellows and a most enjoyable evening was passed. Everything that cordial hospitality could suggest was done for the visitors. The spacious laboratories and their elaborate equipment with machinery of actual working size excited everyone's admiration and should assist in an important way in developing the University and the Dominion.

On reassembling Thursday morning, at 10 a. m., the reading of papers was resumed.

Nodular Granite from Pine Lake, Ontario. Frank D. Adams, Montreal, Canada.

The paper described a granite from a recently surveyed portion of the Province of Ontario which in places contains an abundance of nodules scattered through it. These nodules differ in a marked manner from any of those occurring in the hitherto described nodular granites, among other things in being more acid in composition than the rock itself. They are frequently found to be arranged in long lines which, when followed up, coalesce into sheets having all the characters which are commonly presented by secondary quartzose veins. The phenomenon evidently results from a process of differentiation in the original magma and has an intimate bearing on the question of the origin of 'Contemporaneous Veins.'

Chemical Composition of the Granite from Pine Lake, Ontario. Nevil N. Evans, Montreal, Canada.

The analyses as given below proved that the cores of the nodules were more acid than the rims, a relation the reverse of that met elsewhere.

J. P. Iddings compared these nodules with spherulites in obsidian, and Whitman Cross brought out the lack of correpondence between them and the spherulitic phenomena with which he had become familiar. J. F. Kemp emphasized the contrasts with Craftsbury, Vt., 'prune' granite and the orbicular granite at Quonochontogue, R. I.

	Nodule.	Normal Granite.
Loss	0.92	0.32
SiO_2	81.43	78.83
Al_2O_3	13.70	10.88
Fe_2O_3	1.58	1.63
CaO	0.37	0.22
MgO	0.06	0.35
K_2O	1.28	5.31
Na_2O	1.02	2.13
	100.36	99.67

Experiments on the Flow of Rocks now being made at McGill University. Frank D. Adams and John T. Nicholson, Montreal, Canada.

The paper was presented by Dr. Adams and was illustrated by the lantern, by specimens of the results attained, and by a subsequent visit to the shops to see the machine. The authors have constructed a special crushing machine, much like the usual testing apparatus of engineering laboratories. Their object has been to subject cylinders of various rocks to pressures far above their crushing resistance, yet to confine them so that they could not shatter. After many unsuccessful trials of materials, strips of soft Swedish sheet iron were wrapped around a core of mild steel and welded together. The core was then bored out, the hole carefully polished and given a taper of one in a thousand. These cylinders were about $3\frac{1}{2}$–4 inches high and were turned down in the outer middle part so as to localize any bulging under pressure to this portion. They, therefore, looked like large spools, with thick ends. Cylinders of Carrara marble had meantime been prepared in Germany of the same taper as the holes and of such a size that, when the spools were heated and expanded,

the cylinders dropped snugly in and were caught midway of the spool. The cylinders of marble were about two centimeters in diameter. Chrome-steel plungers were employed in the squeeze, and fitted perfectly in the spools. By using the city water mains, which give at the University a pressure of 135 pounds to the square inch, oil was forced in beneath the piston of the press, and cylinder pressure gauges and a recording curve-tracing mechanism were connected. The blocks were gradually compressed until subjected to thirty tons' pressure. Under this squeeze the marble cylinder bulged at the middle, expanded its iron jacket and approximated a thick disc. When released it was found that it had flowed without losing its cohesion at all. When split down the vertical axis the cross section revealed two opposing paraboloids, or blunt cones of unchanged marble, filled in between with a dense, chalky variety, but all perfectly solid. Thin sections show a great abundance of twinning striations and gliding planes and evidences of strain. Cylinders of Baveno granite are now ready for experimentation, but have not yet been compressed. Peat has, however, been compressed into a black, shining and lustrous substance, very like high-grade lignite or coal, a result similar to that obtained abroad. Copper filings have been compacted also to solid metal. A further apparatus has been designed so that superheated steam can be introduced into the test, which can be kept at 500° F., for months at a stretch, while the compression is progressing, the gauges and recorder meantime registering the pressure at all times. Dr. Adams stated that two and a-half years had been spent in experimenting and six months in getting results.

The Fellows were outspoken in their praise of this work, and it was felt by all to be one of the most important contributions ever laid before the Society. It brings within the domain of experiment some of the obscure proceses of dynamic metamorphism and throws great light on the viscous flow of rocks.

The Geological versus the Petrographical Classification of Igneous Rocks. WHITMAN CROSS, Washington, D. C.

In this paper the aim was to show that much of the confusion in existing schemes for the classification of igneous rocks arises from wrong ideas as to the relations of petrography to geology. Suggestions were made which it is hoped will be useful both to the geologist and to the petrographer.

Dr. Cross presented a very thorough and philosophic review of the vexed question of nomenclature and classification. The distinction was made between petrography, the descriptive part of the subject, and petrology, the discussion of the at present more or less hypothetical or theoretical views regarding the splitting and variations of magmas, etc. Although no actual scheme was suggested, the general bearing of the paper tended toward the development of one that should give widespread satisfaction.

In discussion J. F. Kemp emphasized the importance of having the larger groups of a petrographical scheme, ones that can be used by the student, the mining engineer and by others engaged with rocks, whereas the finer determinations under these general, working groups might be left to the specialist. Such groups must depend solely on mineralogy and texture.

On the Classification of Igneous Rocks. JOS. P. IDDINGS, Chicago, Ill.

The paper involved a discussion of some general principles of classification with special reference to the chemical composition of rocks. The point of greatest interest in the paper was the extremely significant charts that Professor Iddings had prepared on the basis of over 900 analyses.

The ratios of the molecular equivalents of the alkalies to the silica were used as the ordinates, by which the dot indicating the particular analysis was located on the chart, while the actual silica percentages were employed as the abscissas. Very interesting and suggestive groupings of rocks resulted, and charts were shown that exhibited in a graphic way many peculiar points of composition.

Adjournment was then had for lunch. On re-assembling after lunch the following papers were read:

Concentric Weathering in Sedimentary Rocks. T. C. Hopkins, State College, Pa.; read by G. O. Smith.

The paper was a brief explanation of four photographs showing concentric structure in shale and fire-clay beds in western Pennsylvania. In some places they show a double concentric structure; one on a large scale, starting from the joint planes and resembling exfoliation; another on a smaller scale, showing flattened concretions of varying sizes.

New Geothermal Data from South Dakota, etc. N. H. Darton, Washington, D. C.; read by W. B. Scott.

By means of two large scale maps of South Dakota the curious variations in the temperature of the water from the artesian wells of the region were shown. All are warm, but the temperatures differ. Assuming that the temperature of the water indicates the temperature of the rock stratum that yields it, and using this in connection with the depth of the well and the mean annual temperature at the surface, very high rates of increase in depth are shown. They vary from an extreme of 18 feet for 1° F. west of the Missouri river to 35 feet for 1° F. at the last point recorded in eastern South Dakota. Belts were marked off according to the gradients 20–25 feet, 25–30 feet and 30–35 feet per degree. This developed a long, narrow east and west belt of relatively low gradient, projecting westward into the areas of higher gradient, and corresponding to the nearness to the surface of one of the lower geological formations. The maps are, however, necessary to make the relations clear.

Note on an Area of Compressed Structure in Western Indiana. George H. Ashley.

This paper was read by J. J. Stevenson. It emphasized the great lack of any evidences of disturbance throughout Indiana, as the geology of the State presents remarkable regularity of strata. Recently, however, the author had found near Asherville, in the block coal region, a great number of small faults, some even reversed, and cited them as evidence of local compression.

Niagara Gorge and St. David's Channel. Warren Upham, St. Paul, Minn.; read by T. C. Chamberlin.

Having recently again examined the Niagara falls and gorge, with especial reference to the older channel of St. David's, the author believes that a most important element in the history of the gorge erosion has been overlooked by some observers, and that by others its evidences have been misunderstood. This paper shows that the small preglacial stream which eroded the St. David's and Whirlpool channels, having a great depth beneath the river in the Whirlpool, must have flowed for a considerable distance, before reaching that depth, in a gradually widening and deepening ravine, coinciding with the present gorge along the Whirlpool rapids. Because the Niagara River found there a drift-filled narrow ravine, which is cut to the present size of the gorge, its erosion took place in that part by rapids and cascades. Southward from the head of the old ravine the river has eroded its gorge by a great vertical cataract, under which the masses of the Niagara limestone, rolled about by the

power of the waterfall, have worn the river bed to a maximum depth of nearly 200 feet beneath the water surface.

The narrowness of the gorge along the Whirlpool rapids is therefore attributed to the conditions of the river erosion here indicated, rather than to decrease of the volume of the river by diversion of the water of the upper lakes to flow from Lake Huron eastward. Studies of the glacial Lake Agassiz convince the author that the progress of the epeirogenic uplift of the northern United States and Canada from the Champlain depression was too rapid to accord with the hypothesis of any outflow from Lake Huron toward the east during the long time that would be required for the Niagara River, while thus diminished, to erode the gorge along the Whirlpool rapids. The explanation here given accords mainly with Dr. Julius Pohlman's discussion of the Niagara history, but differs concerning the age of the river and of postglacial time, which is estimated, as from Professor N. H. Winchell's discussion of the Falls of St. Anthony, to have been between 5,000 and 10,000 years.

The Princeton Expedition to Patagonia. W. B. SCOTT.

Professor Scott gave an outline of the remarkably rich finds made by the Princeton expedition, whose gatherings already amount to 20 tons and include 1,000 skulls. Mr. Hatcher is again on the ground and will remain three years. The results at present reached show that much revision is necessary of the Argentine stratigraphy as at present published. The lowest beds examined, constituting the Patagonian a marine formation, are Oligocene or lowest Miocene and are equivalent to the Miocene of New Zealand. The overlying Santa Cruz beds of volcanic ash, possibly lacustrine, are not older than the middle Miocene. The upper series or Cape Fairweather beds are Pliocene. All the fossils are in great contrast with those of North America, and the investigator finds himself in a new world. They show foreshadowings of the present South American types. Notwithstanding the incomplete stage of the investigation, many details were given by the speaker which were of the greatest interest to the Society.

The following papers were read by title:

Location and Form of a Drumlin at Barre Falls, Mass. WILLIAM H. NILES.

Drift Phenomena of the Puget Sound Basin. BAILEY WILLIS.

Notes on the Geology of the Rocky Mountains of Montana. WALTER H. WEED.

Weathering of Alnoite in Manheim, N. Y. C. H. SMYTH, JR.

On the Occurrence of Corundum in North Hastings, Ont. A. E. BARLOW.

The regular business of the meeting being concluded, the Society passed resolutions of thanks for the extremely hospitable reception that it had received from the resident Fellows, especially Professors Adams and Porter, and from the authorities of McGill, and then adjourned. In the evening the usual banquet was held in the Windsor Hotel and proved a very enjoyable conclusion of the exercises of the week.

All the visitors were greatly impressed by the new buildings and fine laboratories of McGill, and repeatedly expressed their appreciation and admiration for the gifts of Mr. McDonald, who has been largely responsible for the recent expansion. The advance of one university is a stimulus and an encouragement for all.

J. F. KEMP.

COLUMBIA UNIVERSITY.

IOWA ACADEMY OF SCIENCES.

THE twelfth annual session of the Iowa Academy of Sciences was held on December 27 and 28, 1897, with Professor T. H.

Macbride, of the State University, presiding. A goodly number of scientific workers of Iowa and adjoining States were present, among them Professor J. E. Todd, State Geologist of South Dakota; Mr. Frank Leverett, of the United States Geological Survey; Charles R. Keyes, former Assistant State Geologist of Iowa and later State Geologist of Missouri; Professor F. W. Sardeson, of the State University of Minnesota; Professors Calvin and Shimek, of the State University; Professors Weems, Osborn and Ball, of the State College at Ames; Professors Page, Arey, Newton and Mortland, of the State Normal School, Cedar Falls; Mr. R. I. Cratty, of Armstrong; Professor T. M. Blakeslee, of Des Moines College; J. L. Tilton, Indianola; L. S. Ross, Des Moines; W. S. Hendrixson, Grinnell, and others.

'Some Geometrical Generalizations,' by T. M. Blakeslee, was a discussion of a method whereby a number of geometrical theories could be put under one, itself a special case of a more general proposition, and hence more easily proven.

In the absence of Professors Combs and Pammel, papers on 'Comparative Histology of Corn Leaves' and 'Comparative Anatomy of the Fruit of Corn' were presented in summary by Professor C. R. Ball. The study was undertaken to determine, if possible, variations of structure that could be used in selection of varieties specially adapted to Iowa climate.

'Occurrence of *Termes flavipes* in Iowa,' by Herbert Osborn, noted the observation of the white ant, so common in Southern States, at LeClaire.

In a paper by Professor C. C. Nutting, 'Do the Lower Animals Reason?' the ground was taken that this faculty exists among lower members of the animal kingdom. In the discussion following the reading a number of instances supporting the views advanced in the paper were cited by different members.

Professor Herbert Osborn, in a paper, 'Additions to the List of Iowa Hemiptera,' enumerated ninety-seven species that had been hitherto unrecorded. Some of them were new to science, and two species that present striking mimicry and dimorphism were described in detail.

The same author, in 'Coccidæ Occuring in Iowa,' discussed the species of scale insects observed in the State, giving characteristics by which they might be recognized and calling special attention to the probability of introduction of the San José Scale, the means by which it is distributed, and the necessity for prompt recognition should it appear.

'The Hemipterous Fauna of Northwestern Iowa,' by the same author, presented results of a collecting trip in the northwestern counties and showing the occurrence in this area of species which belong properly to the plains of Nebraska and the Dakotas; also, some forms that occur normally in more southern localities, but seem to follow up the Missouri river; still others that are boreal in distribution, but that occur in the northwestern corner, and, so far as known, only in that part of Iowa.

The President's address, by Professor T. H. Macbride, of the State University, began with an interesting review of scientific work of the year past. Especial mention was made of the contributions by Iowa scientific workers, members of the Academy. This was followed by a prophetic outlook on the work that lies before Iowa scientific workers, the speaker giving unqualified commendation to those researches which result in practical value to mankind.

Professor B. Shimek read a paper on the 'Flora of the Sioux Quartzite in Iowa.' The researches presented, which form a continuation of those prosecuted in former years, resulted in the addition of a number of species. A comparison was drawn between conditions existing in June and

August, and the meeting of Eastern and Western flora in this region were discussed.

Professor T. H. Macbride read a paper on 'The Myxomycetes of the Black Hills.' These minute and interesting organisms which thrive in moist climates exist here under conditions that would seem very unfavorable. They are, however, much dwarfed as compared with those occurring in most localities in eastern Iowa, and, while affording an abundant variety, are such as would be recognized anywhere as very peculiar and poor.

'Idiocerus and Pediopsis,' by Herbert Osborn and E. D. Ball, included a discussion of generic affinities and species occurring in North America. Some of the species are abundant on various trees and of economic importance.

Papers by Professor Fitzpatrick on 'The Flora of Northeastern Iowa' and 'The Flora of Southern Iowa' were read by title.

What proved to be a very spirited discussion on the formation of the loess of the western part of the State and other portions of Iowa was opened by the paper of Professor B. Shimek on 'Is the Loess of Aqueous Origin?' followed by one on 'The Degradation of the Loess,' by Professor J. E. Todd, State Geologist of South Dakota. Professor Shimek presented a vast array of evidence, mainly from the occurrence and distribution of the mollusca, to support his view that parts at least of this formation could not have been deposited in water. The facts presented had been gathered with the greatest care, and the evidence most thoroughly sifted so that the conclusions must command wide attention.

Professor Todd presented numerous cases where the loess material gave evidence of creeping and ravining, and the formation of secondary deposits in which the determination of fossils became difficult.

Dr. C. R. Keyes presented a paper on 'The Carboniferous Formation of the Ozark Region,' embracing results of recent work and a statement of equivalent formations for different parts of the area.

Professor Calvin, in a paper on 'Some Anomalous Valleys and Paradoxical Divides in Delaware County, Iowa,' called attention to the peculiar habit, noted in the eastern part of the State, of streams turning aside from low plains to follow chasms cut in highlands that rise from forty to fifty feet above the plains from which the stream turned aside.

One of the most interesting features was a symposium on interglacial formations in Iowa, and participated in by Messrs. Calvin, Leverett, Bain, Udden and Fitzpatrick.

Professor Calvin opened with a discussion of the 'Interglacial Deposits of Northeastern Iowa,' describing the forest beds and gravel formations and discussing the significance of the gravels and the availability of the term Buchanan as a name for an interglacial stage.

In papers on 'The Weathered Zone (Sangamon) between the Iowan Loess and the Illinoisan Till Sheet' and 'The Weathered Zone (Yarmouth) between the Illinoisan and Kansan Till Sheets,' Mr. Leverett discussed the characteristics of the deposits and proposed names for each soil horizon. Mr. Bain considered 'The Aftonian Deposits of Southwestern Iowa,' locating typical exposures and presenting evidence to show that in southwestern Iowa there are cases of a drift sheet of unknown extent earlier than the Kansan and separated from it by an interval of unknown but considerable length. It is believed to represent one of the theoretical earlier and minor advances of the ice.

The paper by J. A. Udden, on 'Preglacial Peat Beds,' was a consideration of the peat beds and soils under all the drift and upon the rock surface.

Professor T. J. Fitzpatrick discussed 'The

Drift Section and Glacial Striæ in the Vicinity of Lamoni.'

The facts brought together in this symposium serve to clear up a number of debated questions relating to the glacial and interglacial deposits in Iowa, and must serve as a most substantial basis for any further studies of this interesting and important subject.

The following papers read by title were referred to the Secretary for publication in the Proceedings:

L. H. Pammel, J. R. Bumip and Hanna Thomas, 'Comparative Study of Berberidaceæ.'

L. H. Pammel, 'Notes on Fungi in Iowa for 1896–7.'

G. W. Carver, 'Notes on Fungi in Iowa for 1895–6.'

This meeting of the Academy was one of the best attended and most interesting in its history.

Its next annual meeting will be held in December, 1898.

The following officers were elected for the ensuing year: President, Professor T. H. Macbride, Iowa City; First Vice-President, Professor B. Fink, Fayette; Second Vice-President, Professor M. F. Arey, Cedar Falls; Secretary-Treasurer, Herbert Osborn, Ames; elective members of Executive Committee, Professors S. W. Beyer, Ames; A. C. Page, Cedar Falls; and W. H. Norton, Mt. Vernon.

Herbert Osborn.
Secretary.

CURRENT NOTES ON ANTHROPOLOGY.

THE PRE-MYCENÆAN CULTURE.

A score of years ago the early history of Greece was bounded by a Homeric fog, a thousand years or so B. C. Then came the brilliant researches of Schliemann at Hissarlik, Tiryns and Mycenæ, and the fog lifted to reveal the vivid and potent Mycenæan culture at its acme, about 1500 B. C. Now, once more, the clouds have rolled away, and investigations on the islands of the Archipelago and the mainland of Greece have disclosed to us, with abundant clearness, the 'pre-Mycenæan' culture, extending from about 2000 to 3000 B. C.

It is simple and rude, that of the Grecian folk before they had been touched by the Promethean fire which transformed them to the noblest artists of all time. The statues of stone are misshapen and incomplete; the pottery is generally coarse, and it is doubtful if its moulders knew the potter's wheel; its decoration is in lines and spirals only, animal figures being unknown; neither the sword nor gold had yet been discovered; tattooing was common; and the general condition was that of barbarism.

A full, well illustrated and instructive article on this culture is that of C. Blinkenberg, in the Memoires de la Société Royale des Antiquaires du Nord, 1896.

CONTRIBUTIONS TO THE STUDY OF THE STONE AGE.

Professor Enrico H. Giglioli, of Florence, has recently published a number of interesting papers bearing on the industries of the stone age in various parts of the world.

In one he describes, from an unpublished MS., the stone age in New Caledonia as it now exists. It is in the neolithic stage, but the period is not far distant when it emerged from paleolithic types. Another article describes various stone implements still in use among the tribes of the Rio Napo, in South America. They are principally axes of various sizes and forms. Again, from Melaneria, he figures and describes the formidable maces of the natives of New Britain, made of hard wood, the end armed with a perforated stone, spheroidal in shape. Finally, in a note with several illustrations, he explains the use of the stone-armed threshing machine still a common implement in Tunisia. These and

other articles by Professor Giglioli are published in the *Archivio per l'Antropologia e l'Etnologia*, Florence.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

IN the *Comptes Rendus* the question of the identity of argon with nitrogen is taken up by H. Wilde, and the description given of an attempt to convert the spectrum of the one into that of the other. At a pressure of one millimeter and temperature of —76° the electric spark was passed through nitrogen for eight hours, but the spectrum remained unchanged. A negative result was also obtained when a strong spark was passed for eighteen hours through nitrogen at a pressure of twenty atmospheres. The spectrum of argon also remained unchanged by the passage of the spark at a pressure of three millimeters at a temperature of —76°.

THE work of Moissan on the metallic carbids and silicids has now been carried out, in conjunction with P. Williams, on the borids of the alkaline earths. Calcium borate, aluminum and carbon are heated together in the electric furnace. Calcium borid is obtained as a fine black powder which under the microscope consists of transparent, yellow, cubic crystals. They scratch the ruby, and are fusible at the temperature of the electric furnace. The crystals do not burn in the air until heated to redness; fluorin attacks them in the cold, chlorin at a red heat; hydrogen is without action at this temperature. Water is without action upon the crystals until a temperature of 1000° is reached. The fused borid is, however, acted upon by water with evolution of hydrogen. The borid has the formula CaB_6, but there seems to be a less stable borid with a smaller proportion of boron. The strontium and barium borids are similarly formed and possess analogous formulæ and properties. The borids of the alkaline earths thus do not fall in the same class with the carbids and silicids.

PROFESSOR MICHAELIS, of the University of Rostock, has published, in the last *Berichte*, the description of a considerable number of organic compounds of selenium, tellurium, antimony and bismuth. The tetrachlorids of selenium and tellurium unite with aromatic ethers, phenoles and ketones, giving products in which two atoms of chlorin are replaced by the organic radical. When the dichlorid of selenium is used, both chlorin atoms are replaced. The close analogy between selenium and tellurium is shown in these compounds. With antimony chlorid, anisol and phenetol react in benzene solution only in the presence of metallic sodium. Compounds of antimony with three and two anisyl groups are described, as well as a number of addition products in which the antimony is quintivalent. Analogous bismuth compounds are similarly formed. The whole work forms a valuable contribution to the relatively little known field of the compounds of organic radicals with the elements of higher atomic weight.

IN the above number of the *Berichte*, Melikoff and Pissarjewsky discuss the constitution of the salts of peruranic acid, which have been previously studied by Fairley. They consider the salts to have the formula $(R_2O_2)_2UO_4$, and to be compounds of the metallic peroxids with uranium tetroxid. By treatment with aluminum hydroxid they succeed in actually decomposing the salts into the peroxids and UO_4.

GEORG BERG has added to the number of 'complex acids' a compound of titanic acid with malic acid. As described in the *Zeitschrift für anorganische Chemie* it has the formula $2TiO_2.C_4H_6O_5$, $6H_2O$ and crystallizes in minute white prisms. When ammonia is led over it, three molecules of the water of crystallization are replaced by ammonia,

giving another instance of the chemical resemblance between H_2O and NH_3.

IN the *Z. Ver. Rübenzucker-Industrie*, A. Herzfeld has a series of articles on lime (CaO) and its compounds. They refer largely to experiments carried out in a furnace of special construction for the purpose of solving the chemistry of lime making. Among other conclusions reached, we note that in the presence of superheated steam the complete burning of lime takes place at 200° lower than in air; that water will expel the carbon dioxid from all its compounds at 800°; and that the overburning of lime is occasioned almost exclusively by the presence of silica.

A NEW locality for Chili saltpeter has been discovered, according to H. Thoms, in the *Journal für Landwirtschaft*, in southwest Africa in the Kharas Mts. and on the Orange River. The mineral, known locally as Klipzweet, or Boomester, appears as an efflorescence on the rocks, and is used by the natives as a valuable remedy for many ills. Analysis shows it to contain chiefly sodium and potassium nitrates and chlorids, about three parts of sodium to one of potassium, and four parts of nitrate to one of chlorid; it may thus be considered to be an impure Chili saltpeter. No particulars are given as to its abundance, or possible economic importance.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE MARINE BIOLOGICAL LABORATORY AT WOODS HOLL.

THE winter meeting of the Trustees of the Marine Biological Laboratory was held in Boardman Hall, Cornell University, upon December 30th. Twelve members of the Board were present, including the President, Professor Osborn, of Columbia; the Secretary, Professor Bumpus, of Brown; Chairman of the Executive Committee, Dr. E. G. Gardiner, of Boston; Professor Clarke, of Williams; Professor Macfarlane, of Pennsylvania; Professor Penhallow, of McGill; Professor Metcalf, of Baltimore; Professor Patten, of Dartmouth; Professor Morgan, of Bryn Mawr; Professor Peck, of Williams; Professor Wilson, of Columbia; Professor Trelease, of St. Louis. Professor Conklin, of the University of Pennsylvania, was present at the preliminary conference held on Tuesday evening.

The Secretary reported that the Laboratory Prospectus for the summer session of 1898 had been prepared by the Director and was ready for distribution. This prospectus for the eleventh session of the Laboratory provides for the representation of nearly all the universities of the country in the corps of lecturers and instructors. Investigation in Zoology will be under the direction of Professors Ayers, Bumpus, Conklin, McMurrich, Metcalf, Morgan and Morrill. The embryological course will be under the direction of Dr. F. R. Lillie, of Michigan, assisted by Messrs. Strong, Crampton, Treadwell and Professor Clapp. The course in Anatomy will be under the direction of Professor Peck, of Williams, assisted by Messrs. Dahlgren, Greene, Lefevre, Murbach, Packard and Waite. The course in Physiology will be under the direction of Professor Loeb, of Chicago, assisted by Messrs. Norman and Lyon. The course in Botany will be under the direction of Professor Davis, of Chicago, assisted by Messrs. Moore, Caldwell, Harper, Fairchild, Webber, Swingle and Esten. The institutions represented in the whole staff are: Missouri, Brown, Pennsylvania, Michigan, Baltimore, Bryn Mawr, Hamilton, Columbia, Miami, Mt. Holyoke, Princeton, Leland Stanford Jr., Johns Hopkins, Detroit High School, Chicago, Harvard, Texas, Bradley Institute, Lake Forest, New York Experiment Station and the United States Department of Agriculture. Special seminars in Embryology and Neurology will be conducted by Drs. Conklin, Morrill and Strong. A course of historical lectures will be given by the Director and Drs. Wilson, Morgan, Wheeler, Watasé and Mall. Upon the list of regular evening lecturers upon General Biology are those who have already contributed to the regular evening course, together with some others. The course of instruction in

Scientific Drawing, by Dr. Arnold Graf, formerly a student of Professor Lang, will be continued in five lectures and demonstrations of all the various methods employed in the illustration of scientific works. The session will extend from June 29th to August 10th. A new feature of the embryological course is that the Director will associate with himself in the lectures a number of specialists in the different groups of vertebrate and invertebrate animals. This admirable prospectus for the coming season was heartily approved by the Trustees and ordered for distribution.

The Treasurer's report showed a balance of $838 to meet the initial expenses of the coming year, and directed attention to the fact that while many members of the corporation had not as yet paid their dues the expected income from this source will be ample to meet the initial expenditures.

Mr. Gardiner presented a written report to the corporation of the work of the Executive Committee since the last meeting of the Board in September, and recommended certain improvements in the Laboratory buildings at Woods Holl—which were approved. The matter of coöperation between the Laboratory and the United States Fish Commission was also discussed and referred to a special committee who will confer with the new Commissioner to be appointed by President McKinley. The preparation of the decennial report of the Laboratory, which will contain a historical notice, was also referred to the Executive Committee.

THE ESTABLISHMENT OF THE 'UNIVERSITY TABLE' AT NAPLES.

ONE of the most gratifying results of the Ithaca meeting was the hearty response given to Professor Anton Dohrn's offer to American naturalists in respect to the work at Naples, during his recent visit to this country, namely, that if three tables were established by America he would find places for as many students as came over from this country. For several months past efforts have been made to supplement the subscription of Mr. William E. Dodge, of New York, originally designated as a 'Half-year Columbia Table,' and establish what might be termed an 'American University Table' in distinction from the 'Smithsonian Table' and the proposed Table of American Colleges for Women. Mr. Dodge, upon the recommendation of Professor Osborn, had very liberally consented to drop the name 'Columbia' and continue his subscription under the general designation 'University.' At the business session of the Naturalists, as has been already noted in this JOURNAL, Professor T. H. Morgan brought forward the resolution to appropriate $100 from the Treasury of the Naturalists towards this University table, and this was unanimously approved. Upon the following day, at the meeting of the Trustees of the Marine Biological Laboratory, Professor H. C. Bumpus, promised to secure an addditional $100 upon behalf of the Marine Biological Laboratory and the Anatomical Laboratory of Brown University. He has promptly fulfilled this pledge, and the University table is now fully established for the present year at least, with the prospect of continuance. Inasmuch as Professor Bumpus has secured the $100 in the name of the Woods Holl Laboratory, it is eminently appropriate that the Laboratory should have a voice in the appointment of delegates to this table. This appears to be secured by the personnel of the Naples Committee, nominated by the Temporary Chairman, Professor Clarke, namely, Professor T. H. Morgan, Bryn Mawr; Professor H. F. Osborn, Columbia University; Dr. C. W. Stiles, Washington, D. C.; to either of whom applications may be made.

GENERAL.

THE agricultural appropriation bill, carrying $3,323,402, has been approved by the House of Representatives in committee of the whole. An amendment to strike out the appropriation of $130,000 for the free distribution of seeds was lost by a vote 19 to 155.

THE Director of the Geological Survey has been directed by Congressional resolution to prepare a map of Alaska showing all known topographic and geologic features, including the gold-bearing rocks, with a descriptive text, the text to include an explanation of the best known routes and methods of reaching the gold fields. 40,000 copies are to be printed.

A BILL will be brought before the next session of the British Parliament appropriating upwards of $15,000,000 for the rebuilding of South Kensington Museum.

MR. E. W. MAUNDER, Mr. C. Thwaites and the Rev. J. M. Bacon, with the parties under their direction sent by the British Astronomical Association for the observation of the total solar eclipse which occurs to-morrow, had, as we learn from the London *Times*, arrived at Bombay on January 4th The other observing parties had also arrived. The different observing stations will be as follows: Mr. Maunder and Mr. Thwaites will be stationed at Talni, on the Great Indian Peninsula Railway, between Amraoti and Nagpur; the Rev. J. M. Bacon at Baxar. Mr. W. H. Christie, the Astronomer Royal, and Professor H. H. Turner, forming the third official party sent out by the joint committee of the Royal Society and the Royal Astronomical Society, will be stationed at Sahdol, between Katni and Bilaspur. The observing party from the Government Observatory at Madras, under the direction of Professor Michie Smith, will be at Indapur.

MR. JACOB H. SCHIFF has given $10,000 to the New York Public Library for the purchase of scientific books.

A BRONZE statue of Charcot by Falguière will be erected in the Saltpetrière, Paris.

WE learn from the *Auk* that Mr. George K. Cherrie has resigned his posision as assistant curator of ornithology in the Field Columbian Museum, and has sailed for Bolivar, Venezuela, which he proposes to make the base of exploration in the upper Orinoco region for the period of a year or more.

THE Academy of Sciences, Paris, has nominated as first choice M. Maquenne, and as second choice M. André as candidates for the chair of physiological botany in the Paris Museum of Natural History, vacant by the death of M. Georges Ville.

M. RENÉ CAGNAT has been made a member of the French Commission on Scientific Museums, in the place of the late M. du Courdray La Blanchère.

MM. BERTHELOT, Bourgeois, Fallières and Liard have been appointed members of the Council of the Paris Museum of Natural History, with M. Berthlelot as President.

IT is stated in *Nature* that Mr. George Sharman retired at the end of last year from the post of paleontologist to the Geological Survey of Great Britain, with which he had been connected since 1855.

DR. OTTO FINSCH has been appointed director of the ornithological division of the museum at Leiden, in succession to Dr. J. Büttikofer, who, as we announced sometime since, has accepted the directorship of the zoological garden at Rotterdam.

MR. WALTER SICHE, the traveler and florist, has, says *Knowledge*, returned from an expedition to the Cilician and Cappadocian Taurus, with a large number of alpine plants and ten thousand examples of various species of the asphodel family, with varieties of fritillary, galanthus, colchicum, iris and many other plants. Mr. Siche has been the means of introducing many new flowers to the domain of English horticulture.

THE Rev. Charles L. Dodson, from 1855 to 1881 mathematical lecturer at Oxford and the author of valuable contributions to mathematics and logic, has died at the age of sixty-six years. Mr. Dodson is known to every one as 'Lewis Carroll,' author of 'Alice in Wonderland' and other tales, which have delighted innumerable children and older people.

WE regret also to record the deaths of Sir Charles Hutton Gregory, an eminent English civil engineer, on January 10th, at the age of eighty-four; of Mr. Charles Cornevin, professor of hygiene and zoology at the Veterinary School at Lyons, and of Dr. Edward Lindeman, astronomer at the Observatory of Polkowa, aged fifty-three years.

THE National Geographic Society has announced for to-night a meeting in honor of the late Gardiner G. Hubbard, at the time of his death President of the Society. Mr. Alexander Graham Bell, will preside, and the program thus far arranged includes addresses by the following: Surgeon-General George M. Sternberg, U. S. A., on behalf of the joint scientific societies of the District; Dr. Philip G. Gillette,

on behalf of the American Association for Teaching Speech to the Deaf; Dr. B. L. Whitman, on behalf of the Columbian University; Dr. Marcus Benjamin, on behalf of the Society of Colonial Wars; W. L. Wilson, on behalf of the Smithsonian Institution; Mr. A. R. Spofford, Assistant Librarian of Congress, on behalf of the Columbia Historical Society; Major J. W. Powell, of the Bureau of Ethnology, and probably Commissioner Ross, representing the District. General A. W. Greely will close the meeting with a review of the ten years' work of the Geographic Society, representing the labors of Mr. Hubbard, its late President, during the latter years of his life.

THE British Institute of Public Health will in future be styled the Royal Institute of Public Heath. Queen Victoria has accepted the office of Patron of the Institute, and has conferred the Jubilee Medal upon the President, Professor W. R. Smith, M. D. The Council of the Institute has conferred the Harben Gold Medal for 1898 upon Lord Playfair, and has appointed Professor W. R. Smith, Harben Lecturer for the year 1899, and Mr. Henry C. Jones, Solicitor, Secretary to the Institute.

MR. DAVID HUNT, of Boston, has arranged to give four lectures on the 'History of Medicine,' at the Harvard Medical School, on Thursday evenings. The first of the series was given on January 11th, the subject being 'Hippocrates to the Sixteenth Century.'

AT a meeting of the Zoolgical Club of Springfield, Mass., on January 5th, Mr. W. W. Colburn was elected President, and Miss M. A. Young, Secretary. Dr. George Dimmock made a report on the card catalogue of the fauna of the region being prepared under the auspices of the Club. 1,940 species have been listed, the most complete portion being that on birds.

A LINCOLNSHIRE Science Society with several sections has been organized, with a view to advancing the interests of natural history and founding a museum in the county.

THE Nominating Committee of the Appalachian Mountain Club, Boston, has named Professor William H. Niles for President, Mr. Rest F. Curtis for Vice-President, Mr. R. B. Lawrence for Recording Secretary and Mr. John Richard, Jr., for Corresponding Secretary.

MR. VICTOR HORSLEY, the President-elect of the Neurological Society, London, gave his inaugural address at the annual meeting of the Society on January 13th. The subject of the the address was 'The Degree of Discharge of Different Nerve Centers.'

QUEEN VICTORIA has decided to convert the old palace at Kew, near the Botanic Gardens, into a public museum.

M. HOERST has applied to the city of Paris for permission to begin the construction of the colossal terrestrial globe to be erected under the direction of M. Elise Recluse for the Paris Exposition of 1900.

PROFESSOR NORDENSKJOLD, the Arctic explorer, has informed the Swedish Academy of Sciences that the Foreign Office has received intelligence that several persons worthy of credence saw Herr Andrée's balloon early in August, in British Columbia, seven miles north of Quesnelle Lake, in the district of Cariboa.

THE statements contained in the daily and other papers regarding the will of the late Alfred Nobel appear to be only partially correct. His personal estate in Great Britain has been valued at £434,093, but the amount set aside for the foundation of the five great prizes is not yet known. It will be remembered that according to the terms of the will the interest of the fund is to be divided into five equal parts, of which one part is to devolve upon him who, within the department of natural philosophy, has made the most important discovery or invention; one other part to him who has made the most important discovery or improvement in chemistry; one other part to him who has made the most important discovery within the department of physiology or medicine; one other part to him who in literature has produced the most excellent work in an idealistic direction; and one part to him who has worked most or best for the fraternization of the nations and for the abolition or diminution of standing armies, as also for the promotion and propagation of peace. The prizes in physics and chemistry are to be awarded by the Swedish Academy of Sciences, for physiological

or chemical work by the Carolinian Institution in Stockholm, for literature by the Academy in Stockholm, and for the propagation of peace by a committee of five persons to be elected by the Norwegian Parliament.

CHAS. D. WALCOTT, Director of the U. S. Geological Survey, will have, in the next issue of *Appleton's Popular Science Monthly*, an article on 'The Preservation of our Forests,' and President David Starr Jordan an article on 'The Evolution of the Mind.'

WITH the January number *The Journal of School Geography* has been enlarged to 40 pages, and the editor, Professor Richard E. Dodge, Teachers' College, New York, announces that it will be improved in several ways. Particular attention will hereafter be given to mathematical geography, elementary meteorology and commercial geography. Mr. Andrew J. Herbetson Collington, Scotland, has become associate editor for Great Britain.

THREE packages of yellow fever serum from Dr. J. Sanarelli, of the Institut de Hygiene Experimentale at Montevideo, have been received at New York, intended for Dr. Wyman, of the United States Marine Hospital service at Washington and for Dr. Doty. Part will be used in experiments made by Dr. Doty's assistant, Dr. C. B. Fitzpatrick, at the laboratory at Quarantine.

UNIVERSITY AND EDUCATIONAL NEWS.

AT a meeting of the Corporation of Yale University on January 13th it was decided to appoint a committee to prepare plans for the proper celebration, in October, 1901, of the bicentennial anniversary of the granting of the charter to Yale College.

AT a special meeting of the Council of Columbia University, on January 13th, action was taken as authorized by the Board of Trustees, incorporating the Teachers' College as a professional school for the training of teachers. President Low will become President of the Teachers' College, but the Trustees of the College will be continued as an independent board, responsible for the financial administration of the College. The Teachers' College was founded in 1887, Professor Nicholas Murray Butler, of Columbia University, being the first President. In 1893 the College was partially affiliated with Columbia University for educational purposes. The buildings of the College, erected at a cost of about $1,000,000 on land given by Mr. George W. Vanderbilt, are adjacent to those of Columbia University and Barnard College. The foundation of a professional school for the training of teachers of the same rank as university schools for medicine and law is one of the most important advances ever made in educational methods.

DISCUSSION AND CORRESPONDENCE.

A PROPOSED ADDITION TO PHYSIOGRAPHIC NOMENCLATURE.

THE rocky mass of the earth, the lithosphere, is mantled in large part by formations whose particles or grains are loosely aggregated, either incoherent or feebly coherent. To these formations collectively Merrill has given the appropriate name *regolith* (stony mantle), a term approximately coördinate with lithosphere, hydrosphere and atmosphere. It was not proposed until its need had come to be distinctly recognized, and I believe it will be promptly adopted in geology and physiography. But a companion term is equally needed. The lithosphere is composed of rock, the hydrosphere of water and the atmosphere of air; of what does the regolith consist? There is no compact name for its material, although surface geology and physical geography have found occasion to mention it so frequently and under so many relations that there are plenty of descriptive phrases. Lying above the firm rock, it is *superficial* or *surficial material*. Having been formed by the breaking up of rock, it is *disintegrated material*. Because destined eventually to coalesce as rock, it is *unconsolidated material*. As a substitute for these binomial terms I propose the word *discrete*.

The adjective *discrete* comes to us along with *discreet*, from the Latin *discretus*, separate. *Discreet* is now appropriated by a secondary meaning, wise, but *discrete* means only separate, incoherent, discontinuous. In converting it into a technical noun I propose to retain this adjective meaning and add the idea of stony

material, making *discrete*=discontinuous stony material, or the material of the regolith.

Portions of the material of the regolith are already well named. Part of it is sedentary, the remainder transported. The sedentary portion has been called *geest* (Le Duc, McGee) and *saprolite* (Becker). The transported portion is sometimes broadly included under the term *drift*, but it is more commonly classified by genesis as *alluvium*, *glacial drift*, etc. *Discrete* is proposed to include all these.

It is proper to add that for many years I have personally felt the need of a succinct term for this idea, and that I have already made experimental use of the word *discrete* in two courses of lectures on physiography as well as in unpublished manuscript. Despite Dr. Branner's deprecation,* I cannot avoid the feeling that such tests, when critically applied, are of practical value, and I therefore venture to hope that the new word will be found useful by some of my colleagues in physiographic study.

After the writing of the preceding paragraphs my attention was directed to the fact that the noun *discrete* is already in print. It is used in the sense here proposed, but without definition, in a Johns Hopkins thesis by my friend Dr. A. C. Spencer.† G. K. GILBERT.

WASHINGTON, D. C.

*SCIENCE, N. S., Vol. VI., 1897, p. 134.

†The Geology of Massanutten Mountain in Virginia. Published by the author. Washington, 1897. See p. 33.

HARVARD'S METEOROLOGICAL WORK ON THE WEST COAST OF SOUTH AMERICA.

TO THE EDITOR OF SCIENCE: In a previous communication on 'Meteorology in South America,' published in SCIENCE, October 1, 1897, pp. 523–525, the writer gave some facts as to the meteorological work now being done in Brazil and in the Argentine Republic. It would seem well to supplement the information given in that letter with some notes on what has been and is being done in Peruvian meteorology.

With the exception of the observations made at the 'Unanne' observatory in Lima, all the meteorological work now being done in Peru is being carried on by the Astronomical Observatory of Harvard College. Harvard's astronomical and meteorological work in Peru is the result of a bequest left to the Harvard College Observatory by the will of Mr. Uriah A. Boyden, in 1887. By the terms of the will this money was to aid in the establishment of an observatory "at such an elevation as to be free, so far as practicable, from the impediments to accurate observation which occur in the observatories now existing, owing to atmospheric influences." In order to determine the best site for the new observatory, it was necessary to make a more or less careful study of the meteorological conditions, especially as affecting the visual conditions, at various places which seemed to promise well. Accordingly preliminary stations at which astronomical and meteorological work was temporarily carried on were established in 1888 and 1889 in Colorado and in California. It was, however, thought advisable, for various reasons, to place the new observatory within the tropics, and accordingly an expedition was sent out in 1889 to make a study of the meteorological conditions, and of the availability for astronomical work, of various places along the west coast of South America. There is, as is well known, along this coast a narrow strip of desert, which extends roughly from latitude 4° to 30° S., over the greater part of which rain seldom or never falls. This desert strip, about 1,800 miles in length from north to south, is probably best known to scientific men, and to the world at large, as containing the rich nitrate fields of northern Chili, which were seized by the Chilians in the late war with Peru. These nitrate deposits which have, since the war, furnished the greater part of the revenues of Chili, are essentially a product of the dry climate of this interesting region.

The expedition above referred to was in charge of Professor Solon I. Bailey, of the Harvard College Observatory, and reached Lima on March 6, 1889. After a survey of the surrounding country it was finally decided to place a temporary station on a summit about 20 miles northeast of Lima, at an altitude of 6,600 feet above sea-level. This summit, which had previously been unnamed, was called Mt. Harvard. Meteorological observations on Mt.

Harvard were made from May, 1889, to September, 1890, inclusive, and embraced those made with standard, maximum and minimum thermometers, rain-gauge, barograph and thermograph, sunshine and pole-star records.

Owing to the approach of the cloudy season and to the consequent difficulty of carrying on work with the meridian photometer, Professor Bailey and his party left Mt. Harvard in November, 1889, in order to spend the succeeding cloudy months in a study of the meteorological conditions of other parts of the coast farther south, with a view to selecting the most favorable site possible for the location of the permanent observatory. On this trip Arequipa was visited and a study made of its availability as a site for the observatory. Farther south, Pampa Central, in the desert of Atacama, was visited and a system of observations of cloudiness started, which were continued (thrice daily) from December 14, 1889, to August 23, 1890. In this region there is absolutely no vegetation, not even the cactus growing there. Pampa Central is in a rich nitrate field, and is distant from the Pacific Ocean about 80 miles, its altitude being 4,530 feet above sea-level.

In October, 1890, Arequipa having then been chosen as the permanent site for the observatory, the Mt. Harvard station was given up. The exact site of the observatory was chosen by, and the buildings erected under the supervision of Professor Wm. H. Pickering, who came to Arequipa in January, 1891, and remained in charge of the station for two years. Since that time Professor Bailey has been in charge.

The meteorological observations above referred to, made at Mt. Harvard and at Pampa Central, were not the first made in Peru under the auspices of the Harvard College Observatory. By means of correspondence carried on in 1887 and 1888 Professor E. C. Pickering had already been able to establish four meteorological stations, at which observations were begun in November, 1888, viz.: Mollendo, Arequipa-Vincocaya and Puno. At Arequipa observations have been continued from that date down to the present time, and at Mollendo they were continued until 1896, when the station was removed to Mejia, a neighboring town, close to sea-level on the Pacific Ocean. At Puno the observations were discontinued in March, 1889, and at Vincocaya in November, 1890. All these places are on the line of railway running from Mollendo, on the Pacific, to Puno, on Lake Titicaca, at an altitude of 12,540 feet. The whole length of the line is 325 miles. Vincocaya, at an altitude of 14,360 feet, was, at the time when observations were there made, the highest meteorological station in the world. It is situated on an extensive level plateau, barren except for some sparse desert vegetation, and is very near the crest of the western range of the Cordillera, the highest point on the line of the railway being at Crucero Alto, 14,666 feet, a short distance east of Vincocaya. The instruments used at Vincocaya were maximum and minimum and dry-bulb thermometers, rain-gauge, wind-vane and thermograph, and observations were also made of cloudiness. At Puno, situated towards the western end of Lake Titicaca, no thermograph was in operation.

The meteorological stations at present at work under the auspices of the Harvard College Observatory in Peru are the following: Mejia, La Joya, Arequipa, Pampa de los Huesos, Mont Blanc, Misti Summit, Cuzco and Echarati. These stations are roughly in a S.-N. line, and extend from the seacoast across both ranges of the Cordillera and down to 3,300 feet, in a valley at the head of the Amazon river system. A brief description of these stations, and of the instruments in operation at each one, may be of interest. The station at Mejia has, since January, 1896, replaced that which had existed at Mollendo from 1888 through 1895, and as the two places are near together, and have similar topographic surroundings, the continuity of the records has not been seriously interfered with. Mejia is situated on the Pacific, 9¼ miles from Mollendo, the port of Arequipa and the terminus of the railroad. The instruments are 55 feet above sea-level and 420 feet from the sea. The surrounding country is extremely desolate, there being only the most scanty vegetation, except where irrigation is possible. Behind Mejia there is a range of hills, barren and unattractive, and all around it there is an abundance of

drifting white sand, which gives the whole region a most inhospitable appearance. The instruments at Mejia are the dry- and wet-bulb and maximum and minimum thermometers, rain-gauge, wind-vane, Pickering sunshine-recorder, barograph, thermograph and hygrograph. Observations are made thrice daily, at 8 a. m., 2 and 8 p. m., and include, besides the records of the instrumental reading, observations of clouds (kind, position, amount) and of wind velocity (estimated). This seacoast station is especially valuable as giving data concerning the climatic conditions of the desert belt, where its climate is modified by the proximity of the ocean.

The next station inland from Mejia is at La Joya, a railroad station distant from the ocean about 40 miles, and situated in the center of the elevated pampa of Islay, at an altitude of 4,141 feet above sea-level. This pampa lies east of the coast range of mountains, and is almost completely devoid of vegetation. It is surrounded by hills, and is very largely covered, towards its eastern margin, with the curious traveling sand crescents known as *medanos*, which move across the desert from south to north, in the direction of the prevailing day wind. These *medanos* are composed of white sand, apparently quite different from that which makes up the rest of the desert surface, and they are a very striking feature of the landscape. The meteorological conditions at La Joya are very interesting, and the records will furnish abundant data for the study of what we may call *desert meteorology*, which would include such characteristically desert phenomena as mirages and dust whirls. The instruments at La Joya are similar to those at Mejia.

The central station is at the Observatory, in Arequipa. Arequipa is situated at a distance of about 80 miles, in a direct line from the Pacific Ocean, and lies on both sides of the river Chile, the water from which is extensively used in irrigating the neighboring fields. Although the surrounding pampas can support only scant vegetation, the city itself lies in the midst of green fields of wheat, barley, Indian corn and *alfalfa*. The Observatory is built on high land overlooking the city, and stands at an elevation of 8,050 feet above sea-level, being about 500 feet above the city. Its exact location is lat. 16° 22′ 28″ S.; long. 4 h., 46 m., 12 sec. To the north, about 12 miles distant, rises Charchani, 20,000 feet high; to the northeast, 10 miles away, is the Misti, 19,200 feet; and to the east comes the serrated ridge of Pichu-Pichu, an extinct volcano, 18,600 feet high. Arequipa, at a considerable distance from the ocean, and in close proximity to several high mountains, presents meteorological conditions, a study of which is peculiarly interesting. Observations are made at 8 a. m., 2 and 8 p. m. daily. The instruments in use are the following: Wet- and dry-bulb, maximum and minimum, solar- and terrestrial-radiation thermometers; mercurial barometers, rain-gauge, anemometer and anemoscope, Pickering sunshine recorder, barograph, thermograph and hygrograph. The observations include, in addition to readings of the instruments, tri-daily records of clouds (kind, position and amount), and of the visibility of the three neighboring mountains. Earthquake records include two observations daily of the seismograph and seismoscope, and two daily records are also made of changes in the level of the ground.

The fourth station, still farther inland, is on the so-called Pampa de los Huesos, about 30 miles northeast of Arequipa, at an elevation of 13,400 feet above sea-level. This pampa is composed of volcanic sand and ashes, and is almost completely barren. There being no possibility of securing an observer in this desolate region, readings of the wet- and dry-bulb thermometers are made whenever a visit to the shelter is possible, at which times, also, the sheets of the barograph and thermograph are changed.

On the flank of the Misti above the Pampa de los Huesos, at a height of 15,700 feet, is the fifth station, known as 'Mont Blanc,' because the altitudes of this station and of that on the summit of Mont Blanc are almost exactly the same. The 'M. B.' shelter, as it is called for brevity, is at a distance of about 300 feet from the hut where observers from Arequipa, on their way to visit the meteorological station on the summit of the Misti, spend one night. The instruments are wet- and dry-bulb and maximum and minimum thermometers, thermograph and barograph; and this station is visited, as is that

on the Pampa de los Huesos, when an expedition is made to the summit.

The most interesting of all the meteorological stations in Peru—indeed, the most interesting meteorological station in the world, because it is the *highest in the world*—is that on the summit of the Misti, at an altitude of 19,200 feet above the level of the sea. This was established by Professor S. I. Bailey in October, 1893. The shape of the Misti is that of an almost perfect, although more or less truncated cone, and the conditions of exposure of the instruments are as nearly perfect as it is possible to obtain on a mountain. The instruments now in use on the summit are dry- and wet-bulb and maximum and minimum thermometers, rain-gauge, barograph, thermograph and hygrograph. There is also a meteorograph, constructed by Fergusson, of Blue Hill Observatory, especially for this station, and designed to record temperature, pressure, humidity, and wind direction and velocity, and to run three months without re-winding. This meteorograph has not yet given as complete records as it was originally hoped would be obtained from it. For some months after its establishment the Misti station, together with the Huesos and Mont Blanc stations, was visited by one of the assistants in the Observatory once in ten days, but lately not more than one visit a month has been possible. The trip is by no means an easy one, and the altitude of the Misti is so great that almost every one going there suffers from *soroche*, or mountain sickness. The writer has twice visited the 'highest meteorological station in the world' during his present stay in Peru, and both times had some experience in the unpleasant symptoms of *soroche*. Although it has thus far been impossible, in view of the great altitude and the distance of the station, to secure complete and continuous records from it, still the broken records which have been obtained are so interesting that this, to a considerable extent, makes up for their fragmental character.

The seventh station is at some distance farther north, at Cuzco (lat. 13° 30′ 55″ S.; long. 74° 24′ 30″ W., approximately), lying in a valley between the eastern and western ranges of the Cordillera, at an elevation of 11,378 feet above sea-level. It is rather an interesting fact that here, in the ancient capital of the Incas, a North American university should be maintaining a meteorological station. Cuzco is at present distant from Arequipa five days' journey; two days being spent in the train, one in a vehicle and two on horseback. The instruments are wet- and dry-bulb and maximum and minimum thermometers, rain-gauge, wind-vane, Pickering sunshine recorder, barograph and thermograph.

The last station, the farthest from Mejia, is Echarati, on the eastern slopes of the eastern ranges of the Cordillera, and in the fertile valley of the Urubamba, about 130 miles north of Cuzco. Echarati is at present just at the outer limits of what may be called civilized Peru, for a short distance beyond it comes a wild territory, inhabited altogether by Indians, through which white men seldom pass. When first established, in 1894, the shelter was at Santa Ana, about 30 miles nearer Cuzco, but last year the instruments were removed farther north, to their present location. The equipment is the same as at Cuzco. The altitude is 3,300 feet.

A glance at a good map of Peru will show at once what a magnificent series of stations Harvard has thus established in this hitherto meteorologically unknown country. Reaching from sea-level across the desert pampa of Islay to Arequipa, they continue on up past 13,400 and 15,700 to 19,200 feet, and then down, towards the north, to 11,378 feet and finally to 3,300 feet. The line of stations thus cuts diagonally across the desert belt of Peru and extends through a region of increasing rainfall down to the well-watered valley of Urubamba, which belongs to the Amazon water-shed. That the large number of observations already collected in Peru, and now being tabulated for publication, will furnish data of the greatest interest and value is a foregone conclusion.

R. DEC. WARD.

HARVARD COLLEGE OBSERVATORY,
AREQUIPA, PERU, December 1, 1897.

THE CRUSTACEAN GENUS SCYLLARIDES.

WHILE looking into the anatomy and nomenclature of the Astacoidean crustaceans, I in-

cidentally learned that the only species of *Scyllarus* known to Fabricius* in 1775, when he first made known that genus, was the *S. arctus* —the *Cancer arctus* of Linnæus. That, being the only species, is necessarily the type, and, therefore, the name *Scyllarus* must be retained for it. The early carcinologists (Latreille, White) correctly recognized the type. Nevertheless, the *S. arctus* was taken as the type of a new genus—*Arctus*—and the name *Scyllarus* was reserved for the "*Sc. sculptus, latus, squamosus, equinoxialis, Haanii, Sieboldi,*" by Dana in 1852. He was doubtless influenced in this respect by the consideration that the *arctus* was the only species of its genus known to him, while most belonged to the other one. All succeeding carcinologists have followed him, and, indeed, the family is one of the very few for which a classification proposed nearly half a century ago has been retained intact to the present time, new species only having been added meanwhile. However, the necessity for a change will be recognized by almost every zoologist, and the sooner it is made the better it will be. I, therefore, propose to restore *Scyllarus* to the typical species, and to give the new name *Scyllarides* (*Scyllarus* with the Greek patronymic termination *-ides*) to the bereft genus. *Scyllarides* may be typified by the *S. æquinoctialis* (*Scyllarus æquinoctialis* of Nicolaus Tönder Lund).†

According to Dr. Ortmann (Zool. Jahrb., Syst., 268, X., 1897), there are five well defined species of *Scyllarides—squamosus, latus, haani, æquinoctialis* and *elizabethi*.

THEO. GILL.

WASHINGTON.

LAMARCK AND 'A PERFECTING TENDENCY.'

PROFESSOR JOHN GARDINER has done well to recall the fact that the chief factor in evolution, according to Lamarck, is not the so-called 'Lamarckian factor,' but '*a perfecting tendency.*' Lamarck's Histoire Naturelle is in perfect accord with his Philosophie Zoologique, as interpreted by Professor Gardiner. Lamarck thus describes his two factors: (1) '*Composition progressive,*' '*progression,*' '*plan de la nature,*' "*pouvoir qui tend sans cesse à compliquer l'organisation, à accroître le nombre et le perfectionnement des facultés,*" "*cause première et prédominante.*" (2) "*La cause accidentelle n'ayant pu altérer la progression en question, que dans des particularités de détail, et jamais dans la généralité des organisations.*"

The editors of the second edition of the Histoire Naturelle add a foot-note (Vol. I., p. 114) which concisely states Lamarck's position: "Il y a donc, d'après Lamarck, deux causes toujours agissantes sur les animaux, l'une qui tend à les perfectionner d'une manière uniforme dans leur organisation, l'autre modifiant irrégulièrement ces perfectionnements, parcequ'elle agit selon les circonstances locales, fortuites, de température, de milieu, de nourriture, etc., dans lesquels les animaux vivent nécessairement."

Lamarck repudiates the '*échelle graduée*' of Bonnet, and claims there is no identity between it and his '*composition progressive.*'

C. O. WHITMAN.

SCIENTIFIC LITERATURE.

Recent and Coming Eclipses. By SIR NORMAN LOCKYER, K.C.B., F.R.S. Macmillan & Co. 1897.

This volume, consisting mainly of articles which have appeared from time to time in current periodicals, is issued with a view to supplying the general reader with information regarding the latest phases of the chief eclipse problems.

The treatment divides itself into two parts. The earlier chapters of the work contain elementary explanations of the theory of eclipses, and that of the instruments used in their observation. The spectroscope in its various forms is discussed in detail, and much stress is laid on the efficiency of the slitless spectroscope or 'prismatic camera.' The application of this

* Systema Entomologiæ, p. 413, 1775.

† The proper authority for the species (generally known as '*S. æquinoxialis* Fabr.') has been given by Miss Rathbun in the Annals of the Institute of Jamaica (I., 43). The excellent memoir of Lund (Om Slaegten Scyllarus < Skrivter af Naturh. Selskabet, II., p. 17–22, 1793) has been ignored by almost all others. It was referred to by White, but the references to Lund were mostly given after those to Fabricius.

instrument to many of the problems of solar physics is dwelt upon at length. A chapter is also devoted to the various simple observations which can be made without the use of elaborate apparatus. Following this preliminary discussion is an account of the eclipse expedition to Kiö Island, with a description of the arrangement of the camp and apparatus, and an account of the development of the latent observational powers of the officers and crew of H. M. S. 'Volage,' which had been detailed to assist in the expedition. Then comes the story of clouds, failure and the retreat. A chapter is now devoted to the success at Novaya Zembla, where Mr. Shackleton succeeded in obtaining the spectrum of the chromosphere by means of a prismatic camera. This finishes what has been referred to as the first part of the work.

What follows is devoted to the bearing of eclipse observations up to date upon the question of the composition and distribution of the solar atmosphere. It is stated that the 'flash spectrum' of the chromosphere is radically different from the ordinary absorption spectrum with which we are familiar, and that therefore the chromosphere is not the seat of most of the absorption. Comparisons are made with arc and spark spectra and that of 'hot stars' with a view to showing that the chromosphere is hotter than the absorbing media, which must therefore be situated higher up in the solar atmosphere. The step from this proposition to dissociation is a short one, and, with the satisfied conclusion that "The eclipse work strengthens the view that chemical substances are dissociated at solar temperatures," the author closes his book.

In brief, it may be said that the features of the work are the stress laid upon the importance of the prismatic camera in eclipse work, the account of the volunteer corps of the 'Volage,' and the exposition of the vindication of the dissociation hypothesis by all the phenomena of solar and stellar spectroscopy.

While there is no denying the fact that in the slitless spectroscope we have one of the most powerful instruments for the prosecution of eclipse work, it seems doubtful whether it will accomplish all that our author, its warmest advocate, expects from it. It is hoped to get a definitive spectrum of the corona, by means of subtracting from the spectrum of the *whole eclipse*, obtained with an integrating spectroscope, that portion which is due to the chromosphere alone. This latter is to be determined by the prismatic camera. It is not impossible that a line might be common to both chromosphere and corona, but shine so feebly in the latter that its presence would be masked by the continuous spectrum. In such a case the line would be assigned to the chromosphere alone. It would, therefore, seem as though the true solution of the problem is to be expected from the slit spectroscope, part of the slit being made to lie on the moon's shadow In order to make such an attack complete many parts of the corona should be covered. With an instrument of the probable dimensions of that described by Sir Norman Lockyer the field of the collimator should be flat enough to allow several images of the sun to be used. These could be twisted by means of reversion prisms so that any portion of the corona could be brought upon the slit. In this manner the regions surrounding the sun could be well commanded.

It will be seen that in the case of the integrating spectroscope the full efficiency can not be developed, as the central part of the lens will be covered by the dark cone of the moon. Again, and this is more or less in the same line of argument, the brightness of a line will be an average of the brightness of that color over the entire field, while with the instrument provided with a slit we have maxima and minima, which is important in the case of faint lines. For these and other reasons it seems doubtful whether the great power the instrument described might not be used to better advantage in some manner other than the one proposed.

It is expected, by means of the prismatic camera, to decide between the two contending hypotheses regarding the distribution of gases in the solar atmosphere. Do the vapors all rest upon the photosphere, and thin out at different heights, or are they arranged in concentric layers? One of the methods suggested is as follows, to quote Sir Norman Lockyer: "There is a very definite way in which the photographs taken with the prismatic camera may indicate the presence of layers of vapors concentric with the photosphere, but not reaching down to it.

At a certain height above the photosphere the chromosphere spectrum in a photograph of the chromosphere visible at any one instant beyond the edge of the moon will show arcs of certain relative intensities. As the moon advances and gradually uncovers the base of the chromosphere the same arcs will remain visible, but those produced by a layer which does not extend down will be reduced in intensity as compared with arcs produced by vapors which do reach lower down; the latter will continue to get brighter, while the others remain at the same absolute intensity. As the lowest part of the chromosphere is shown in the photographs taken immediately after totality, or exactly at the end, it is only necessary to compare the relative intensities of the arcs in different photographs, in order to investigate the general question as to the existence of layers."

Let us now consider what we should be led to expect under the hypothesis that all the gaseous envelopes rest upon the photosphere. There are no grounds for believing that those

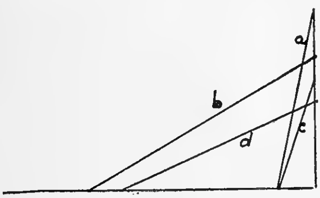

FIG. 1.

gases which extend the highest should be intrinsically the brightest. In fact, we should expect extent and brightness to depend largely upon separate conditions. In Fig. 1 let the ordinates represent the height of a point above

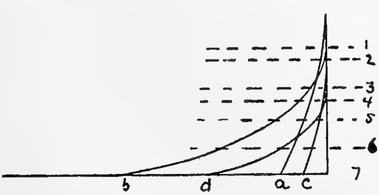

FIG. 2.

the chromosphere, and the abscissæ the brightness of a gas at that point. The lines a, b, c and d are supposed to represent the relation between height and brightness of four different gases. For simplicity, and in the absence of definite information upon the subject, these lines are assumed to be straight. If the examination is made close to the photosphere the *effective* intensity of the arc will be proportional to the amount of gas uncovered per unit of length along the moon's edge. Fig. 2 has been roughly sketched to indicate the effective intensity at different levels. Fig. 3 shows the

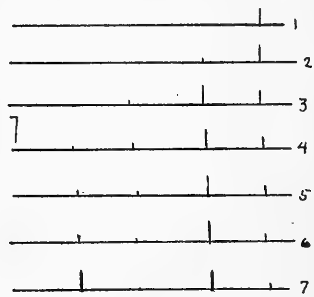

FIG. 3.

relative intensities of the lines at the levels indicated. If the extent of some of the vapors is so great that their arcs have a considerable area the case is still further complicated. If we understand our author aright, a series of photographs corresponding to Fig. 3 would indicate layers d and b resting on the photosphere, followed by c higher up and finally by a alone. It is true that a rough scale of *absolute* brightnesses might be built up by comparing the middle of the arc with portions nearer the cusps, but such an arrangement would be only approximate, and is evidently not intended by the author. It is not, therefore, at once apparent that the riddle proposed by the relative intensities of a large number of lines belonging to different gases is easy of solution.

It is with regret that the reader finds throughout the work statements and suggestions to which, perhaps, for a want of comprehension of exactly what is meant, he is forced to issue a

mental challenge. The one just discussed is an example; others might easily be cited, for instance the reasoning leading to the conclusion that prominences are not of the chromosphere and must, therefore, come from the outside. But space forbids further discussion in this direction.

The training of the volunteer corps of H. M. S. 'Volage' was ingeniously planned and carried out with pains. Parties consisting of those fitted for certain classes of work were organized and regularly drilled for some time preceding the eclipse. In training the sketchers, former coronas were thrown on a screen by means of a magic lantern and, after some practice, remarkable proficiency was shown in accurately drawing the objects, within the eclipse interval of time. It is doubtful, however, whether results of value are to be had from drawings of the corona. Since such very short exposures are required completely to fog a photographic plate the question of getting faint outlying details is merely one of contrast, and with skillful exposure and development there seems to be no reason why the camera should not be considered superior to the sketch-book in delineating eclipse phenomena, as it has shown itself to be in innumerable other branches of research.

With regard to the bearing of solar work in general on dissociation, it is safe to say that the consensus of scientific opinion is not with Sir Norman Lockyer. While dissociation is admitted as a possibility, it is not considered that a preponderence of evidence has given it the standing of a scientific fact. It is claimed that for astrophysics there is laid the foundations of an exact science. But as yet the superstructure has not neared completion. Peculiar characteristics of spectra accompany certain physical conditions. Good work has been done in the direction of associating the one with the other, but it is only a beginning. It is doubtful whether most scientists consider that the influence of all our terrestrial conditions upon the spectrum has been determined, or even guessed, to say nothing of those which may exist in the sun and stars. In time to come, when knowledge becomes more definite on some of these points, and the effect of influences probably existing in the sun has been allowed for, we may, with a mental reservation, assign the residual anomalies of solar and stellar spectra to some condition which we suspect to exist. Until then this line of attack is to be followed with caution.

"In the course of the spectroscopic solar investigations which have been going on since 1868 I have had to point out over and over again that the phenomena observed could be more easily explained on the hypothesis that the chemical elements with which we are familiar here were broken up by the great heat of the sun into simpler forms" etc. In the present state of our knowledge it is somewhat of a problem how much of a figure the question of 'ease' should cut. We call to mind the fact that, on account of insufficient experimental data, the phenomena of light were more *easily* explained to Newton by the emission hypothesis than by the wave theory. And we are not all Newtons.

In closing, however, it is to be said that Sir Norman Lockyer has given us an interesting book, one particularly so to the general public. Technical subjects are explained in simple language, and the mere recital of facts and theories has been relieved from time to time by digressions upon subjects of a more human nature. This is particularly so in the account of the 1896 eclipse expedition. It is hoped that the volume will give to amateurs and others who may witness the coming eclipse such a knowledge of some of the problems awaiting solutions as will enable them to make intelligent observations which may be of interest to themselves and of use to science.

W. H. WRIGHT.

LICK OBSERVATORY, December, 1897.

RECENT MATHEMATICAL BOOKS.

Famous Problems of Elementary Geometry. An authorized translation of F. Klein's 'Vorträge über ausgewählte Fragen der Elementargeometrie.' By WOOSTER WOODRUFF BEMAN, Professor of Mathematics in the University of Michigan, and DAVID EUGENE SMITH, Professor of Mathematics in the Michigan State Normal College. Boston, Ginn & Co. 12mo. Pp. ix+80.

Augustus De Morgan, who in his day waged such merry war with the circle squarers, got half the delight of battle from the fact that he had to meet his foes in single combat and pepper them with small shot, a kind of warfare from which he was sure to emerge with joyous triumph and an appetite for more. To chase his prey through a tangle of reasoning had to his versatile mind the zest of a fox hunt. To kill all the foxes at one discharge would have spoiled his sport. Until very recently the circle squarer had one safe retreat. Nobody could logically dispose his general thesis. And, beside, he had philosophic and scriptural authority. A circle is a perfect figure. That which is one span across is three spans around. Even the august Legislature of Indiana was lately beguiled by a *savant* from Hooppole county into enacting that no circle should be *de rigeur* in that State for which the ratio of circumference to diameter was not exactly three and two-tenths. But we have changed all that. The circle squaring fraternity has long had no standing in court, but now a perpetual injunction is out against them. Not only do we now possess a proof of the transcendental nature of the number π, but this proof has been recently so simplified as to be perfectly intelligible at a very early stage of mathematical study.

The mathematical *pi* is inedible without *e*. The modern investigations begin with Hermite's proof of the transcendence of the exponential base in his paper '*Sur la fonction exponentielle*,' *Comptes Rendus*, 1873. Lindemann's celebrated proof of the transcendence of π appeared in the *Mathematische Annalen*, 1882. The connecting step is the establishment of the theorem that in an equation $c_0 + c_1e^k + c_2e^l + \cdots = 0$, the exponents and the coefficients cannot all be algebraic numbers. From Euler's equation $1 + e^{\pi i} = 0$, the transcendental character of π then follows at once. But it was first in 1893 that Hilbert, Hurwitz and Gordan did away with the earlier formidable apparatus and reduced the proof to the present elementary form. The results, together with the modern disposition of the kindred problems of the duplication of the cube and the trisection of an arbitrary angle, have since been made generally available by the publication in book form of Klein's lectures on these subjects. These lectures have already been translated into French and Italian, and we have now, thanks to Professors Beman and Smith, an excellent English version. The present book is well edited and well printed. Every teacher of even elementary mathematics will do well to obtain a copy, not merely for his library, but to be actually read.

The Calculus for Engineers. By JOHN PERRY, Professor of Mechanics and Mathematics in the Royal College of Science, London. London and New York, Edward Arnold. 8vo. Pp. viii+378.

From the title of this book one might naturally expect to find in it a considerable deviation from the prevalent stereotyped treatment of what the author rather deprecatingly calls 'academic' calculus. On inspection, however, the divergence turns out to be about as complete as could well be imagined. The author's aim is to make the methods of the calculus available for the use of students who already have a considerable knowledge of practical physics and mechanics. A great deal can be done in this direction by the aid of a few functions and the simplest rules of differentiation and integration. In the present book the first 266 pages are divided into two chapters, one of which deals, so far as the calculus proper is concerned, with x^n, the other with e^x and sin x. These chapters are filled with an excellent collection of examples drawn from every branch of applied mathematics. To give an idea of the diversity in this regard, I cannot do better than to quote from the index, which is in itself a commendable feature of the book. Under B, which supplies one of the shortest lists in the index, we have: Ballistic effects; Basin, water in; Beams, fixed at ends, of uniform strength, shear stress in, standard cases; Beats in music; Belt, slipping of; Bending, in struts; Bessels; Bifilar suspension; Binomial theorum; Boiler, heating surface of; Bramwell's valve gear; Bridge, suspension. Very many of the examples are of a kind to be very appropriately introduced into the 'academic' books; and considering how completely latter-day writers on

the calculus have plucked Williamson and Todhunter and each other, I recommend a raid on Perry by way of refreshing variety.

Having got his reader fairly into the calculus, the author finally confesses a weakness for the subject and adds a third chapter of 'academic exercises,' in which he treats the subject of the usual text-books, only in a different order and briefly, but nevertheless including differential equations, Bessel's functions and spherical harmonics.

Even the student who has already studied the calculus in the usual systematic form will profit by traversing it with the author; and to the engineer the book must be very useful. The lecture style in which it is written often makes the subject more attractive. It also sometimes carries away the author, in an excess of enthusiasm, into expressions of opinion which are not to be taken too seriously nor yet to be 'skipped,' as the author advises in the cases of difficult passages.

F. N. COLE.

COLUMBIA UNIVERSITY.

SOCIETIES AND ACADEMIES.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO, NOVEMBER, 1897.

A New Human Tænia (*Tænia confusa, Ward*).—The new form has much of the slender appearance and delicate structure of *Tænia solium*, but as regards the size of the proglottids is even larger than *Tænia saginata.* The segments are of almost uniform breadth and very narrow. In addition to a peculiarly constructed head, the worm presents many variations of bodily structure when compared with the ordinary forms. The sexually mature proglottids measure 4–5 mm. long by 3–4.5 mm. wide; the lobes of the ovary are kidney-shaped and two or three times as long as broad; the genital pore is extremely shallow; in all of which respects it differs markedly from either *T. saginata* or *T. solium.* A short distance from the exterior the vagina is provided with a very distinct sphincter muscle. A similar structure was found also in preparations of *T. saginata.* Such a muscle, heretofore, was thought to exist only in other than human Tæniæ. Just before the vagina reaches the receptaculum seminis it becomes highly modified and, unlike that of *T saginata* or *T. solium*, is encircled by a number of small sphincter muscles. As regards the male reproductive system, the testes are smaller than those of *T. saginata*, and a distinct seminal vesicle is present. The terminal or ripe proglottids are of an extreme length, measuring 28–35 mm. long by only 4–5 mm. wide. They never have the peculiar pumpkin-seed shape so characteristic of *T. saginata*, but are of constant transverse diameter, flaring slightly at the posterior end to form a broad base of attachment for the succeeding proglottid. The branches of the uterus number from 11 to 14, and are divided more or less arborescently, resembling those of *T. solium* somewhat in general configuration. The eggs are without pyriform apparatus and measure about 30 by 39 micra. The longitudinal nerves run in strands of from three to five down each side of the body; near the pore the strands separate, part going ventral and part dorsal to the genital ducts. The longitudinal muscles are continuous throughout the body.

M. F. GUYER.

Some Features of the Oögenesis of Sternaspis.—The egg-cells arise in the manner described by Vejdovsky from the peritoneal epithelium of certain blood-vessels, forming a single pair of distinct ovaries, each surrounded by a fold of the peritoneum and opening to the exterior of a distinct oviduct.

As the egg-cell grows a pedicle is formed beneath it, and in this appears a loop of the blood-vessel as described by Vejdovsky. The end of the loop enters the egg-cell.

In early stages the egg-cell contains a large nucleus with prominent nucleolus and reticular cytoplasm. As growth proceeds the cytoplasm begins to assume a radiating structure, centering about the end of the vascular loop. The first yolk-granules deposited appear in the portions of the egg farthest from the point of attachment. The radiate arrangement of the cytoplasm becomes more distinct as yolk is formed, and the region immediately surrounding the vascular loop stains very deeply.

The egg is now pear-shaped, hanging from its stalk with the nucleus in the broader end sur-

rounded by large yolk-spheres. As the egg gradually fills with yolk the cytoplasmic radiations become less conspicuous and shorter. Finally, the egg-cell becomes filled with yolk-spheres, except a small region about the vascular loop, which contains a reticular cytoplasm, from which fine threads pass out among the yolk-spheres. The nucleus is at the opposite end of the oval egg and is almost surrounded by yolk.

Now the vascular loop disappears; the egg, surrounded by its membrane, becomes detached from its pedicle, and the point of attachment becomes the micropyle, lying just over the small cytoplasmic area.

The temporary radiate arrangement of the cytoplasm, resembling in many respects an aster, is apparently closely connected with the deposition of yolk, and with the fact that the egg receives its nutriment from one end, *i. e.*, from the vascular loop.

C. M. CHILD.

Observations on the Cytogeny of Annelids with 'Equal' Cleavage.—Podarke obscura. The segmentation is of the so-called 'equal' type. At the 8-cell stage all the cells are equal in size, and up to the 56-cell stage there are no differences between the quadrants. Five groups of 'micromeres' are formed, which have the same history as the corresponding groups described for other annelids, but the cells d^2 (x) and d^4 (m) are no larger than the other cells of the corresponding quadrants. The median plane of the embryo forms an angle of approximately 45° with the first two cleavage planes.

Bilateral symmetry in the embryo is produced by the formation of a small cell ($x^{1\cdot2}$.) at the 64-cell stage; by the bilateral division of one of the 4th group of micromeres to form the mesoblast, and by the appearance of a bilateral cross at the upper pole, these two latter divisions occurring immediately after the 64-cell stage. From now on the original radial symmetry is rapidly lost.

A few observations on other annelids follow.

Lepidonotus sp. Here are formed the regular number (5) of groups of micromeres, the cell $x^{1\cdot2\cdot}$, and the bilaterally symmetrical cross.

Sthenolais picta. The cross furrow takes and retains the position characteristic of the other annelids, and the cell $x^{1\cdot2\cdot}$ is formed at the usual time and place.

Hydroides dianthus. Five groups of micromeres appear and one of the 4th group divides bilaterally at the surface (mesoderm?). The primary trochoblasts divide but once, thus forming a primary prototroch of 8 cells instead of 16, as in other annelids.

A. L. TREADWELL.

In addition to the above papers the following reviews of recent literature were given during the month: 'The Yolk-Nucleins in Birds and Mammals' (Mertens), F. L. Charles; 'The Correspondence in the History of the Germ Cells in Plants and Animals' (Häcker), Miss M. M. Sturges; 'The Development of the Excretory System of the Myxinoids' (Mass), Miss E. R. Gregory.

NEW YORK ACADEMY OF SCIENCES—SECTION OF BIOLOGY, DECEMBER 13.

IN a paper entitled 'Considerations on Cell-Lineage, based on a Re-examination of some Points on the Development of Annelids and Polyclades,' Professor E. B. Wilson presented observations regarding the origin and relations of the mesoblast in annelids and polyclades which illustrate the fact of ancestral reminiscence in cell-lineage. In some of the Annelids (*Aricia*, *Spio*, *Nereis* and others) the primary mesoblasts have not been properly so-called; for before giving rise to the mesoblast-bands they bud forth cells that may be, in some cases, traced into the wall of the archenteron. In *Nereis* not less than six or eight such cells are formed; these become pigmented, wander into the interior, and finally give rise to the posterior part of the archenteron. In *Aricia* and *Spio* only a single pair of corresponding cells is formed, and they are so small as to play a quite insignificant part in the building of the body. A comparison of these results with those of Conklin on *Crepidula* indicates that the mesoblastic pole-cells of annelids and mollusks are to be regarded both historically and ontogenetically as derivatives of the archenteron, and that the rudimentary cells of *Aricia* and *Spio* are

vestiges or ancestral reminiscences of such origin.

A re-examination of the cell-lineage of a polyclade, *Leptoplana*, shows that, as in the annelid or gasteropod, all of the first three quartets of micromeres give rise to ectoblast, while the second quartet gives rise also to mesoblast, each cell of this quartet segmenting off three ectoblast-cells and then delaminating a large mesoblast-cell into the interior. The third quartet apparently gives rise to ectoblast alone, though the possibility of its producing mesoblast is not excluded. The four macromeres remaining give rise to the archenteron, as Lang describes, first dividing to form four basal cells (corresponding in origin and position with the four basal entomeres of annelids and mollusks) and four much larger upper cells which correspond to the fourth quartet of micromeres in annelids and mollusks. The posterior of these cells always divides before the others, sometimes equally and symmetrically, as in *Discocœlis* (Lang), but more often unequally. The cells thus formed give rise to a part of the archenteron and not, so far as can be determined, to mesoblast.

These observations show that the mesoblast of polyclades is of ectoblastic origin, and they suggest that the origin of mesenchyme-cells from the second (*Unio*, *Crepidula*) or third (*Physa*, *Planorbis*) quartets in gasteropods may be a vestige or ancestral reminiscence of the mesoblast formation in the polyclades. They suggest, further, that the mesoblast-bands (entomesoblast) of annelids and mollusks may have been historically of later origin than the mesenchyme (ectomesoblast)—a view which harmonizes, broadly speaking, with that of Meyer—and that the two symmetrical entoblast-cells, into which the posterior member of the fourth quartet divides in the polyclade may represent the prototypes of the entomesoblasts of the annelids and gasteropods.

Mr. Crampton briefly reviewed his observations on the early history of the egg in *Molgula manhattensis*, as follows: The author emphasized the fact that development begins not with the cleavage or fertilization processes, but even before. From the origin of the primary oocyte until the final assumption of the adult form, there is a continuous series of developmental changes, each stage being based upon the preceding one and conditioned by it.

The growth of the primary oocyte and the formation of the yolk were considered at some length. A true 'yolk-nucleus' arises, as the author believes, from the nucleus, and this by continued growth, and later by fragmentation, gives rise to very small spherules which later, by enlarging, form the yolk-spherules. The yolk-nucleus is an albuminous body closely allied to, if not identical with, the yolk or deutoplasm. This was indicated by a large number of microchemical tests. The yolk-nucleus at a very early stage of the egg was also shown to be the only albuminous body in the cell, for the rest of the extra-nuclear part of the cell is almost exclusively composed of pseudo-nucleinic substances. Evidence was cited which indicated that the yolk-nucleus was formed by the nucleus, and that it enlarged by constant additions to it from the nucleus.

The more important results of a study of the maturation and fertilization processes might be briefly stated, although a fuller account will appear in the published paper. The first maturation spindle arises entirely from the germinal vesicle. It is peculiar in that it is barrel-shaped and does not, as far as can be determined, bear at either end centrosomes or asters. The first polar-body receives sixteen chromosomes, while sixteen remain in the egg. The second maturation spindle is also barrel-shaped and is also devoid of controsomes and asters. Eight chromosomes remain in the egg. The sperm entrance was described and evidence was brought forward to show that the centrosomes of the first cleavage figure were derived from the sperm.

The spindle of the first cleavage figure appears to be formed from the segmentation nucleus, there being no 'central spindle' extending between the centrosomes. The spindle itself was shown to be barrel-shaped, the daughter chromosomes reforming into a vesicular nucleus at the ends or heads of the barrel. A 'zwischen-korper' also arises, as in the maturation stages, by a concentration of the spindle fibres at the equator of the figure. After the reformation of the daughter nuclei, and after division of the cell-body, the paired daughter centrosomes and asters diverge. The

daughter nucleus later moves up between the asters and prepares for the next division. Comparative independence and parallelism of the processes undergone by the centrosomes and asters, on the one hand, and those of the nuclei, on the other, become very strongly probable. Detailed evidence in support of the above points will be given in the published paper.

GARY N. CALKINS,
Secretary of Section.

TORREY BOTANICAL CLUB.

THE first paper of the evening was by Mr. Marshall A. Howe, 'The Genus Anthoceros in North America,' and was illustrated by drawings and specimens. The paper, which will soon appear in print, described three new species and reviewed those before known. Mr. Howe also indicated the intermediate position of Anthoceros between the Hepaticæ and Musci. The antheridia arise within the thallus as nowhere else among Bryophytes; and the archegonia finally become immersed within the thallus, though not endogenous in origin. The sporophyte differs from all other hepaticæ in having stomata and assimilative tissue on the capsule wall, in the presence of continued growth at the base, and in the elongated two-valved capsule. By the bryologist C. F. Austin, of Gloucester, N. J., the cognate genus Notothylas was united with Anthoceros; but it lacks stomata and differs in the form, direction and position of its capsule. Austin's herbarium was sold in England, and now belongs, in part, to the bryologist Pearson, and in part to Owens College, Manchester.

Discussion by President Brown and others followed. Dr. Underwood remarked that he had known Notothylas spores, unlike those of Anthoceros, to germinate without resting-period. *Anthoceros lævis* he finds among the hemlocks at the Botanic Garden at Bronx Park, and elsewhere in moist, flat, sandy and grassy land, fruiting August to November. In California, said Mr. Howe, they occur on banks and in springy places, beginning to fruit in February and shrivelling in May. One of the new species of the California coast is found by Mr. Howe to develop curious globose storage-bodies serving as food-reservoirs to carry the plant over the dry season.

The second communication was by Dr. T. F. Allen, entitled, 'Contributions to the Japanese Characeæ,' composed, in fact, of four papers, soon to be printed, descriptive mainly of certain Japanese Nitella forms displaying interesting correspondences with our own. Dr. Allen then exhibited numerous mounted specimens and etchings and discussed the taxonomic characters. Spore-characters, though important, are not to be relied on exclusively. Measurements of any one species prove very constant. In some the form of the mucro terminating each ray is decisive. The spores afford specific characters both by their arrangement and their markings, as shown by the $\frac{1}{12}$ or $\frac{1}{15}$ immersion lens. Their reticulations are very constant. The spirals which invest the spore are very early formed from the five bracts which form a cup about it and soon become spirally twisted, as all parts of the Characeæ do, and as the protoplasm current does even before its cell has become twisted. Discussing their life-history, Dr. Allen said that the Characeæ increase in part by nutrition dependent on absorption from their radicals. Pluck a Chara with the greatest care to avoid breaking these short unicellular roots, and yet the plant will finally die after the lower cells have yielded up their contents toward the maintenance of the others. *Chara coronata*, the finest of all in showing circulation, survived in his aquarium half a year without any rooting. *Nitella flexilis* will, however, root in the aquarium, seed, germinate and make a protonema, which divides immediately into an upward ray-bearing axis and a descending root-bearing portion.

In answer to remarks by Dr. Underwood and by Professor Burgess, Dr. Allen described the peculiar increase of the plant by absorption of water and by decomposition of sulphuretted hydrogen, occluding oxygen. The spore-shell, formed by thickening and calcareous development of the cell-walls of the enveloping bracts, hardens so as to survive as part of the rock through several geological periods. The aberrant genus Colcochæte among green algæ suggests the Characeæ, in tending to form a spiral around a spore. Chara resembles certain other

algæ, as some Polysiphonias, in forming a cortex by developing a layer of cells on its surface. The latter small cells absorb mineral matter, especially silica and lime. The Characeæ are important purifiers of water by means of this surface absorption. They are also interesting as examples of the great length to which it is possible for a single cell to develop—sometimes reaching 12 feet.

EDWARD S. BURGESS,
Secretary.

MEETING OF THE AMERICAN CHEMICAL SOCIETY.

THE regular meeting of the New York Section of the American Chemical Society was held on Friday evening, January 7th, at the College of the City of New York, Dr. Wm. McMurtrie presiding.

Mr. G. E. Stone exhibited samples of manganese alloys of the following composition:

	Spiegel.	White.	Gray.
Total carbon	4.92	4.45	3.98
Graphitic carbon	......	2.43	3.14
Silicon	1.94	1.51	3.25
Manganese	11.00	11.00	11.00
Phosphorus	0.04	0.04	0.04
Iron, sulphur, etc., difference	82.10	80.57	78.59
	100.00	100.00	100.00

The alloys are characterized by great hardness and strength, as compared with ordinary pig irons.

Mr. P. C. McIlhiney described a method of determining the resistance of electrolytes having the advantage of making readings at very short intervals. The more accurate method of Kohlrausch requires two minutes between readings, while by the method described a reading may be made every five seconds, which was necessary in the work for which the method was devised.

Professor Loeb gave a very exhaustive review of the speculations in regard to variations of the atomic weights, the theories of condensation, of the 'meta' elements and of ideas in regard to simpler forms of matter. He protests against the notion that any simpler conditions would result from assuming that all elements are a form of one element, and considers that the acceptance of a reasonable number of forms of matter is a decided advantage.

Miss Hitchcock reported experiments showing that nitrogen was given off from tungsten and molybdenum oxides when reduced in a current of hydrogen. On lowering the temperature the amount of nitrogen decreased and increased on again raising the heat. Argon and helium were not found. The results obtained on other oxides indicate that nitrogen is generally present and is considered as a cause of obtaining low atomic weights by the reduction method. Further results are promised.

DURAND WOODMAN,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE eighteenth anniversary meeting of the Biological Society of Washington, D. C., was held on the evening of January 7th. The subject of the presidential address, by Dr. L. O. Howard, was 'A Great Experiment in Economic Entomology: The Work of Massachusetts against the Gipsy Moth.' Both the practical and biological aspects of the work were considered. The address will not be published in full, but the practical portion will appear in Bulletin 10, New Series, Division of Entomology, United States Department of Agriculture. The biological portion comprised a consideration of the interesting points which have developed in the course of the work of the committee of the State Board of Agriculture for Massachusetts, under the direction of the entomological adviser, Professor C. H. Fernald. The points especially considered were the analyses of the caterpillars fed upon arsenical poisons, the experiments upon rate of travel, amount and character of food, effects of starving, of heat and cold upon the larvæ, the occurrence of hermaphroditism, of polygamy and polyandry with the adults, the experiments upon the eggs, especially as to the effects of heat and cold, and the very important and interesting work done on the assembling of the adults. More detailed consideration was given to the biological interest attaching to the work as a whole, as an attempt to exterminate a species existing under the most favorable circumstances over a considerable extent of country.

F. A. LUCAS.

SCIENCE

FRIDAY, JANUARY 28, 1898.

CONTENTS:

LOGARITHMS ON THE 'SPOILS SYSTEM.'

WHILE the President of the United States is considering whether he will follow the advice of the naturalists of the country and appoint as Fish Commissioner a really competent man, or accept the recommendation of one of his political friends and select a man who, in the opinion of that friend, knows nothing of the duties of the position, but will 'catch on' if he is given a little time, a good many other people are examining, with no small degree of astonishment, a recent example of the results of managing one of scientific bureaus of the government on the spoils system.

This bureau has just issued its Annual Report, a large quarto volume, and of its 720 pages 325—nearly one-half—are given to the publication of a ten-place table of logarithms! If there never had been a ten-place logarithmic table before this there might be a shadow of an excuse for its publication by the government, but when such tables have been available for more than a hundred years, and can be bought almost anywhere for a small sum, it is difficult to imagine a reason for the printing of this one. Just what it has cost the government from first to last cannot very well be esti-

mated, but it has been put at not less than $20,000 by a widely known newspaper.

In the bureau from which it comes perhaps two or three copies of such a table might be used, but anybody who knows anything about the subject knows that useful tables of logarithms include from four to seven places. The number of problems in which a table of more than seven places would be used is extremely small, and all extension of figures over what are actually used are a nuisance and a real hindrance. That the United States government should suddenly print for free distribution several thousands of copies of this compilation must create, among those who understand, a strong suspicion of a dearth of other printable material.

A little examination of the introductory pages of this extraordinary work will intensify the wonder which its appearance produces. Some space is devoted to the consideration of the elements of trigonometry, assuming that young people who are ignorant of that subject will take to ten-place logarithms from the start.

Mathematicians will be interested and amused by this elementary work, which would properly astonish a high school pupil of the present day. Definitions of the trigonometric functions are quite erroneous and quite inconsistent with accompanying statements. Some novel mathematical principles are laid down, which go far to make the work worthy of preservation. But all of this goes for nothing at present, as no table of logarithmic sines, cosines, etc., appears in the present volume, and it is greatly to be feared that a new administration with less decided antiquarian tendencies may insist on the paramount importance of papers on hydrography, magnetism, geodesy and things of that sort, and thus defer the completion of this table for another hundred years.

The past is secure, however, and the ten-place 'logarithmorum vulgarium' cannot be taken from us, unless, indeed, the government calls in 'for redemption' the entire issue.

The printed tables show that they have been prepared for the select few, meaning the very select few who are ever likely to be found making use of them. Their arrangement might have been worse, but only by printing the numbers in one annual report and their logarithms in the next. No one will deny this who looks at the two broad quarto pages and tries to carry the line of a number, found only at the extreme left, across both pages to the corresponding logarithm, without being 'shunted off.' This difficulty is greatly enhanced by a gap of about three inches of blank paper diversified with binding stitches, over which one is expected to carry one's eye undeviatingly. Still further trouble comes from the absence of all grouping in the individual numbers. Seven figures, and ten figures, where there are ten, are packed up together, while in any well arranged table they are always grouped in blocks of two, three or four, so as to catch the eye readily and to be the more surely carried correctly in the head until written down. Every compiler knows how this matter of grouping and spacing may make the difference between a perfect table and one which is absolutely unusable.

Many other points might be commented upon, but it was not intended to make any extended criticism of a work which quickly proves to be unworthy of extended notice, except as an example of how a government may spend its money during a 'reform' administration. Of the fitness of the author for the task he has undertaken he has himself given the most valuable testimony. He says, "When these computations were begun I was not aware that Baron George von Vega had preceded me in his Thesaurus Logarithmorum Completus." This great work of Vega, which every tyro in computing knows, was published in 1794. This is more than a hundred years ago, and it is not easy to understand how one could seriously think of repeating such a performance without finding that it had already been done. The author thinks he has discovered some serious mistakes in Vega, but he delicately refrains from telling what they are, nor does he say that he has yet learned (a hundred years not having elapsed) that in 1889 Vega's tables were freed from all known errors, those discovered during a use of about one hundred years, and republished in Europe in a cheap form by a process prohibiting additional typographic blunders. Had he known this he must certainly have informed the Secretary of the Treasury that the expense of the present publication might be avoided. Not liking to imitate Vega in every respect, he adopted a different arrangement of numbers and logarithms, which he says is the same as that of 'the admirable tables published by Messrs. W. & R. Chambers, London and Edinburgh, 1885.' For this statement the Messrs. Chambers are surely entitled to action and recovery.

It is but just to the many able and distinguished scientific men serving in the bureau from which this publication comes to say that it was prepared by their chief, published under his name and by his order. They have had nothing to do with it, except, doubtless, to reduce, as far as possible, those errors which yield to ordinary 'proof reading.' Nor must the author be blamed severely, as he is rather deserving of pity. For this costly and worse than absolutely useless production the country is indebted to the 'spoils theory' in politics, and it represents but a minute fraction of what that theory has cost in government scientific work alone. We have good reason to hope that the present administration will avoid the mistakes that must follow in the wake of politics applied to the great scientific bureaus of the government.

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*THE UNITED STATES NAVAL OBSERVATORY.**

THE history of the Naval Observatory, since its separation from the Hydrographic Office, will naturally be looked for in its annual reports, which are found in the reports of the Navy Department. In 1866 the building of a splendid new observatory was commenced on such a scale that several years were required for its completion. In 1894 Secretary Herbert framed regulations for its government, the most impor-

*We have been requested to reprint this article from the *New York Evening Post* of January 19th. If the criticism of the trivial character of the work of the Observatory is well founded the matter should be brought to the attention of those interested in the efficiency of the scientific work of the government. If the strictures are incorrect those responsible for the management of the Observatory should be allowed to reply in a scientific journal.—ED. SCIENCE.

tant feature of which was the establishment of the office of Astronomical Director, subordinate to that of Superintendent. This arrangement was the act of the Secretary himself, and not of Congress. Both the Superintendent and the Director are detailed from the navy, the first being a line officer, the second a professor; but we find no law establishing their offices.

In one point, at least, the advent of the Astronomical Director is marked by a great improvement. During the years before 1894 the annual reports are confused and disjointed, exciting more curiosity than they gratify, and showing no connection from year to year. Since that date they have been clear and well arranged. But this improvement in form only brings out in bolder relief a feature which runs through nearly all these documents. The report of the Astronomical Director for 1897, which has just been issued, fills six pages; a small space, one would suppose, in which to condense the history of a year's work of such an institution. Yet one-half of this space is taken up with particulars which to the lay reader seem trivial. Is it the Secretary of the Navy or is it an astronomer who will want to know, a year after the event, that on September 3, 1896, the 'finder' of one of the telescopes was supplied with a new leather cap? The most elaborate passage in the whole report is devoted to an account of difficulties encountered in raising an 'elevating floor' by steam-pumps and the happy result of substituting water as the motive power. 'To Professor J. R. Eastman, U. S. N., four star-places were furnished; to Professor Edgar Frisby, U. S. N., two star-places were furnished, and to Professor S. J. Brown, U. S. N., nine star-places were furnished,' these gentlemen being all officers of the Observatory. Do these communications between members of the staff interest the world outside? Does the astronomer want to know in detail what objects could not be seen with the telescopes, and what good intentions were frustrated by bad weather and other untoward circumstances? If the importance of a subordinate is to be measured by the number of times he is mentioned by name, the most important man in the place must be a Mr. Kahler, whose office is not stated, but who appears to be a mechanician. This gentleman's work is reported with truly astronomical precision as to dates. On September 3, 1896, the disc of a micrometer head was found bent; he straightened it out the next day. September 8th he supplied the clamp for the draw-tube of a finder. January 19, 1897, he finished grinding a lens. February 18th he cleaned, oiled and repaired the machinery of the dial of one of the telescopes, and so on.

The estimates for the support of the Observatory during the next year are in round number $56,000 for current running expenses, and $34,000 for grounds, roads, building, etc. If to this we add the salaries of officers and professors paid from the navy fund, some $25,000, it will make a total of $115,000. The report of the establishment should certainly give the public such information as will justify this expenditure. We should like to know what important researches are being carried on, what improvements are being made in the observations, and what results of value are likely to accrue to astronomical science. But we have been unable to find, either in the reports or elsewhere, anything to gratify this curiosity. Besides trivalities like those we have already mentioned, the astronomical report gives mostly a highly technical statistical statement of the number of observations made with four of the instruments, and of the progress of the calculations connected with them. It is difficult to perceive how even a professional astronomer could infer anything from the bare facts that 109

miscellaneous stars and 2,832 American Ephemeris stars were observed; that 'in declination the interpolation of the refractions has been finished,' etc.

A curious impression conveyed by the report is that, excepting the Astronomical Director, who has the most important part of all, the professors seem to have less important work assigned to them than the assistant astronomers have. The perfunctory flavor which permeates the whole report is especially strong in the statements of the work of the telescopes: "The positions of two stars were measured for the use of the twenty-six-inch telescope. Eight occultations of stars by the moon and five eclipses of Jupiter's satellites were observed. The diameter of Venus was measured on seven different days, and the sun was examined for spots on four days." Why on four days and no more? The report of the work of one professor is condensed into a single line with the remark that he assists Lieut. Charles E. Fox, U. S. N.

We must in justice state that the Observatory does other than astronomical work. It prepares and publishes the 'Nautical Almanac;' but this is done at the expense of a separate appropriation which we have not included in our statement of estimated expenditures. There is a department of meteorology and magnetism. Why pursue meteorology in the presence of the Weather Bureau and the Hydrographic Office? Sad havoc has been made with the magnetic observations by the building of an electric railway in the neighborhood. There are also departments of time service and nautical instruments, the value of which to the naval service, it is declared, 'cannot be overestimated.' Is not this statement a little strained? It is true that a very impressive list of scientific instruments issued to ships of the navy is given. But the careful reader who makes inquiry will find that the greater number of them can be purchased at prices ranging from 50 cents to $10 each. Do the inspection, care and issue of these instruments really form an important part of the work of the establishment? If they do, it will be well to reflect that the great ocean liners, obliged to make their time in all states of the weather, must be navigated as carefully as a ship of war, and that it costs their owners nothing to inspect and issue the necessary instruments. Every captain is assumed to be competent for this duty, and we can find no record of a case in which the loss of a ship was traced to the imperfection of a sextant, spy-glass or chronometer.

What was the Observatory built for? What do the scientific men of the country and of the world think of its work? What credit does it do the officers of the navy concerned in its management? What relation has its work to the wants of the naval or any other branch of the public service? What measures are taken by the Navy Department to insure its scientific output being of real value? We are unable to find an answer to these questions in any official publication.

CLIMATOLOGY AS DISTINGUISHED FROM METEOROLOGY.

THE term Climatology is very frequently treated as synonymous with Meteorology. There is an important distinction, however. which should be generally recognized. Climatology is a distinct branch of meteorology, an application which should not be confounded with the broader subject.

Meteorology includes, in the broadest sense, the various atmospheric phenomena. The subject may be conveniently divided into two parts: The study of the laws and principles involved in the movements of the wind; the formation of clouds; the formation and precipitation of rain, snow and hail; the absorption and radiation of heat and the like. The second part consists of

the statistical records of the extent and frequency of the changes of the various atmospheric phenomena.

Climatology is a function of these phenomena and should be expressed in terms of the development of organic life. Climatic changes produce, in many ways, more apparent changes in plants than in animals, and they should be taken as the standard in the interpretation of our meteorological data. Many plants are far more sensitive in recording climatic changes than our meteorological instruments. There are localities where the character of the leaf or the peculiar excellence of the fruit produced show peculiarities in the climate which the instruments fail altogether to record, or rather which we have never yet been able to deduce from the ordinary meteorological records. The development of plant life should, therefore, be taken as the standard with which our instruments should be compared and our methods adjusted in order that the elements of climatology may be worked out from our meteorological records.

Climatology is not a simple summation, but a complicated expression involving the general relation of certain functions of meteorological elements, the values of which we do not as yet understand. The principal elements influencing the economy of plant life are temperature, humidity, wind velocity, water supply and sunshine. Within certain limits the activities of the plant are dependent upon the relation between these elements. Thus temperature causes evaporation, the relative humidity and the velocity of the wind control evaporation, while the moisture supply in the soil provides the plant with water to replace that lost by evaporation. The influence of all depends upon the total intensity of the sunshine.

The rainfall, although a very important meteorological element and of great economic and commercial importance, is not considered a factor in climatology, as it is not the immediate source of the water supply of plants. The soil is the receptacle of the rainfall and, through the resistance it offers to the descent of water and through capillary action, maintains the water at the disposal of plants. Hence the moisture content of a soil is an essential factor in climatology. Furthermore, as the soils in the same field may differ greatly in their power to retain water, we may have very different climates over very small areas. With forty inches of annual rainfall the soil may be so open and porous and retain so little moisture that the conditions may be truly arid. We have small areas of truly desert lands in our Eastern States. On the other hand, with only eight or nine inches of annual rainfall there are some soils so retentive of moisture that they will produce good crops with careful and thorough cultivation.

The general relation of these elements may be expressed in very general terms in the following equation:

$$\text{Sunshine}\left(\frac{\text{Temp.} \times \text{wind veloc.}}{\text{Humid.} \times \text{soil moist.}}\right) = \begin{matrix}\text{Const. condition}\\ \text{of plant growth.}\end{matrix}$$

This is but an expression of facts perfectly well known to greenhouse men. It will be seen from this that to maintain constant conditions of growth any marked change in one of the elements must be followed by a change in one or the other of the remaining elements. Thus, if the temperature rises, the wind must fall or the humidity or soil moisture increase. If the humidity increases, the temperature or wind velocity should increase or the soil moisture should decrease. The sunshine should be recorded by the total intensity rather than by the duration. If the intensity should decrease, the other elements should all be lowered and *vice versa.* If the above equation holds, it appears that the change in either the humidity or soil moisture or both must be

relatively greater than the change in temperature. We have here, then, the principle upon which climatology should be worked out. Given a plant whose pedigree and habits of growth are well known, and a daily range in temperature from 65 to 70 degrees, what range of moisture in the soil can the plant stand? what relative humidity? wind velocity? and what intensity of sunshine? With a certain amount of sunshine, what temperature, humidity, moisture and wind velocity are necessary to maintain the favorable conditions of growth? This is climatology, and there is no reason why the approximate relation of these elements should not be worked out for different classes of plants and for different periods of their growth. The florist knows how to control these conditions to produce the development he desires or to mature the plant at any time. He does this by watching the plant itself, using the thermometer merely as an indicator of the changes he makes in the temperature. It is intuition on his part which he can not explain. It is a matter of experience and observation which he can not impart to others. If the meteorologist should observe and record these changes by his instrument as the florist is observing and controling the development of his plants it should be possible to express the relation of the climate in language which could be imparted to others. This applies also to field culture.

One encouraging thing in this conception of climate is the fact that through cultivation we may very materially control the water supply of the soil. As this is an essential element of climate, we have then the power of modifying the climate of any locality to a considerable extent.

As the relation shown in the above equation is between certain functions rather than between the values as expressed in our ordinary meteorological tables, the equation should be written in still more general terms. Furthermore, the conditions favorable for one class of plants are not favorable for others, and the conditions favorable for the growing period of many of our crops are not favorable for the ripening period. The general equation should then be written as follows, the Greek letters standing for certain functions of the elements of which we do not as yet know the values:

$$\psi(s)\left(\frac{\phi(t)\quad\theta(v)}{\Gamma(h)\;\Delta(w)}\right)=k \tag{1}$$

$$\psi'(s)\left(\frac{\phi'(t)\quad\theta'(v)}{\Gamma'(h)\;\Delta'(w)}\right)=k' \tag{2}$$

where $s=$ intensity of sunshine; $t=$ temperature; $v=$ velocity of the wind; $h=$ relative humidity; $w=$ soil moisture; and $k=$ the constant conditions favorable for plant growth. Equation (1) may represent the conditions favorable for the vegetative or growing period and equation (2) the conditions favorable for the ripening or fruiting period. The values for some of the elements may be the same in both equations or they may all be different.

Climatology is thus shown to be the relation between the meteorological elements as measured by the development of the plant.

MILTON WHITNEY.
DEPARTMENT OF AGRICULTURE.

THE AGE OF THE ARTIFACT-BEARING SAND AT TRENTON.

ON three different occasions during the past summer I examined the deposits on the Lalor farm at Trenton, in which numerous artifacts have been found. So far as my observation goes, nothing was seen to prove that they were not *in situ*. In all cases noted they were found with longer diameters horizontal, *i. e.*, in the position they would naturally occur if their age is the same as that of the sand in which they are found. No positive evidence was noted that the sand had been so disturbed that they might have been intruded from above.

On the other hand, they all occur within less than four feet of the surface, in the zone in which the sand may repeatedly have been disturbed by up-rooting of trees, burrowing animals and Indian burials. Nothing of structure was seen in the sand itself by which this crucial question could be positively determined. The 'red clay films' observed at various intervals in the sand are not, in my opinion, lines of stratification at all, nor are they strongly clayey. They are rather zones or bands of infiltration and deposition of ferric oxide which has somewhat cemented the sand grains. Since they are not lines of stratification, the fact that they are continuous above the specimens is not necessarily conclusive proof that the latter are *in situ*. Nevertheless, in spite of the absence of decisive evidence pro or con, I am inclined to the view that the artifacts are *in situ* and not intrusive.

The deposit in which they occur is, in my opinion, dune-sand, accumulated after the river had partially or completely excavated its trench below the level of the Trenton terrace. The reasons for this conclusion in brief are as follows:

1. *The location.* The trenches are all within 100 or 150 feet of the edge of the terrace, which here overlooks a broad sandy flood plain. According to the testimony of those who have explored most thoroughly, the artifacts are found most abundantly in the sand near the edge of the bluff. The location is one peculiarly favorable for the accumulation of wind-blown sand driven by southerly and westerly winds and derived from the steep face of the terrace before it was covered by vegetation. As the river eroded its channel below the terrace level and left bare the freshly cut bank of sand and gravel, the prevailing winds undoubtedly swept sand on to the terrace. Naturally, some would accumulate along the edge of the bluff. I have observed wind-blown sand at many points in exactly similar positions farther north along the Delaware.

2. *The topography.* In the immediate vicinity of the trenches the surface of the terrace is slightly irregular, being diversified by low swells and saucer-like depressions. The surfaces of the swells are more sandy than of those parts of the terrace where the undulations are not present. Occasional large boulders occur on the surface of the terrace, but none were noted on the sandy knolls. Certainly none occur in the immediate vicinity of the trenches. In saying that the surrounding topography is at least *suggestive* of wind action I am not overstating the facts. In this connection, too, it should be noted that the present flood-plain is marked by low dunes now in the process of formation, and the similarity of surface is thus clearly brought out.

3. *The deposit.* Beneath the layer of forest loam, measuring six to ten inches in thickness, there is loose yellowish sand absolutely without structure lines, but traversed by two or three more or less distinct films, which, as noted above, are probably due to infiltration of ferric oxide. Beneath the yellowish sand, which has a maximum thickness of less than three feet, there is a reddish layer of sand, eight or ten inches thick, grading downward into the cross-bedded sand and gravel, which all are agreed is of glacial age and in which the artifacts are not found. In the artifact-bearing sands there is no evidence that it was water-deposited. That it is a local deposit is shown by the fact that it does not occur on the gravel seen in large open pits a few hundred yards distant from the trenches. It seems to be best developed along the edge of the terrace. Its texture is not unlike that of wind-blown sand observed elsewhere, and it is decidedly unlike the sand-beds exposed in the gravel pits. This latter fact, however, does not neces-

sarily separate it from the glacial deposited beds, although it points to such a separation.

If it is wind-blown sand, then the reddish layer between it and the cross-bedded sand and gravel probably represents the upper surface of the Trenton gravel and was the terrace surface during the interval between the accumulation of the glacial gravel and the wind-blown sand. This layer was examined very carefully in the hope of finding proof of its being an old soil. No humus staining, however, was observed, and its absence may be an argument against the view here advanced. It is not a fatal objection, however, since its absence can be satisfactorily explained by the oxidation and leaching which the whole mass has undergone. This action is still going on, for the humus staining is being leached out of the underside of the present soil, as is indicated by its mottled appearance through a zone five or six inches thick.

4. The presence of at least one wind-eroded pebble in the sand lends some strength to this interpretation, although in the light of the studies of Davis and Woodworth on Cape Cod it cannot be regarded as conclusive.

The presence of scattered pebbles in the sand, too large to have been moved by the wind, may at first sight seem to be fatal to this view, but when all the facts are considered it is not so. That man was present is indicated by the artifacts found. The bank from which the pebbles may have been carried by human agencies is hardly more than a hundred feet away. Although the presence of the pebbles may, to some degree, weaken the argument it is not fatal to it.

My conclusions are, therefore, that the artifacts are probably found *in situ*. There is no positive evidence that the sand deposit is water-laid, and there are strong reasons, although perhaps not conclusive, that it is wind-blown. In the latter case it may date from a period much later than the accumulation of the Trenton gravel. It seems most reasonable to suppose that it had accumulated after the river had cut its channel somewhat below the level of the terrace and formed a freehly-cut bluff, from which the sand was derived. The localization of the sand along the present bluff and the reported greater abundance of the artifacts in the sand nearest the bluff supports this conclusion.

Substantially these same conclusions were reached by me at the time of my first visit to this locality, and my later observations served only to confirm them. In a letter to Professor Mercer, written about July 1st, I stated this view as to the origin of the sand, and the same conclusions were expressed to Professor Smock even earlier. Ever since my first visit to this locality I have been of the opinion that these deposits are probably æolian and that they certainly do not represent the closing stages of the Trenton gravel.

HENRY B. KÜMMEL.

LEWIS INSTITUTE, October 25, 1897.

SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

THE first meeting of this Society was held in conjunction with the meeting of the American Society of Naturalists and the Affiliated Societies at Sage College, Cornell University, December 28 and 29, 1897. The following papers were presented:

1. *A Mycorhiza in the Roots of the Liliaceous Genus Philesia.* DR. J. M. MACFARLANE, University of Pennsylvania.

A NEW case of this kind of Symbiosis was fully described and the conclusion reached that while the fungus might for many generations aid the host in the elaboration of protein compounds, ultimately though very gradually the fungus proved a destructive agent.

2. *Studies on some Mycelium, and Fungi from a Coal Mine* (illustrated by lantern views). PROFESSOR G. F. ATKINSON, Cornell University.

THE author described and illustrated by lantern views the remarkable developments of mycelia on the wooden beams, etc., of an abandoned part of a coal mine near Wilkesbarre, Pa. He photographed these by flashlight, and found fruiting specimens by which several of the species were determined.

3. *Is there Basidiomycetous Stage in the Life-History of some Ascomycetes?* DR. E. A. BURT, Middlebury College.

THE author has been unable, by the study of collections made in August, October, November, December, to confirm Massee's observations on the basidiomycetous nature of *Dacryopsis Ellisiana* and, therefore, is unable at present to conclude with Massee that *D. Ellisiana* is a basidiomycetous stage of the Ascomycete *Lecanidion leptosperma*.

4. *Additional Notes on the Bacterial Brown Rot of Cabbages.* DR. ERWIN F. SMITH, Department of Agriculture.

ADDITIONAL studies by the author have shown how the disease is disseminated, how the infections take place, how it persists in localities where it has once appeared, its host plants and how it may be restricted. An account of the economic aspects of the disease has been published by the Department of Agriculture as a Farmers' Bulletin.

5. *Occurrence of Kramer's Bacterial Disease on Sugar Beets in the United States.* DR. ERWIN F. SMITH, Department of Agriculture.

THIS paper calls attention to the existence, in parts of the United States, of a disease of sugar beets resembling, if not identical with, that described by Kramer and Sorauer in 1891–1892, and more recently by Busse. The characteristics of the disease were described.

6. *Are Blepharoplasts Distinct from Centrosomes?* MR. HERBERT J. WEBBER, Department of Agriculture.

BLEPHAROPLASTS, the speaker pointed out, are special organs of the spermatic cells of Zamia, Gingko and some Filicineæ and Equisetineæ, which in certain stages of their development somewhat resemble centrosomes. Two are formed in each generative cell, arising *de novo* in the cytoplasm on opposite sides of the nucleus and about midway between the nuclear membrane and cell wall. The division of the generative cell results in the formation of two antherozoids, one blepharoplast being located in each antherozoid cell. During the division the blepharoplasts burst and the outer membrane becomes gradually extended into a narrow helicoid spiral band from which the motile cilia of the antherozoid are developed.

The blepharoplasts resemble typical centrosomes: (1) in position, being located on the opposite side of the nucleus, and (2), in having the kinoplasmic filaments focused upon them during the prophases of the division of the generative cell. They differ from typical centrosomes, however: (1) in arising *de novo* in the cytoplasm; (2) in growing to comparatively enormous size; (3) in not forming the center of an aster at the pole of the spindle during mitosis; (4) in having a differentiated external membrane and contents; (5) in bursting and growing into a greatly extended cilia-bearing band, the formation of which is evidently their primary function; (6) in their non-continuity from cell to cell.

7. *Spore Formation in some Sporangia.* DR. R. A. HARPER, Lake Forest University.

THIS paper described the homologies in the modes of spore formation in a number of Sporangia.

8. *Two New Organs of the Plant Cell.* MR. WALTER T. SWINGLE, Department of Agriculture.

THE author announced the finding of two new organs or organoids; the one, *Vibrioid*, occurring abundantly in the superficial layers of the protoplasm of some Saprolegniaceæ and Florideæ, and the other a central body in the developing egg of *Albugo candidus*. Both have been observed before but not correctly described. Both are fully described in this paper. The author can suggest nothing as to the function of the former, but thinks the latter plays some part in the delimitation of the egg within the oögonium, and the fusion of the male and female nuclei.

9. *Notes on the Archesporium and Nucleus of Bignonia*. MR. B. M. DUGGAR, Cornell University.

THE author gives a detailed account of his observations on the microsporic and macrosporic archesporium in this genus. The archesporial nucleus is peculiar in possessing a large nucleolar-like structure which does not stain homogeneously.

10. *Some Theories of Heredity and of the Origin of Species Considered in Relation to the Phenomena of Hybridization*. MR. WALTER T. SWINGLE, Department of Agriculture.

OWING to limited time, Mr. Swingle treated only the part of his subject which relates to facts of hybridization and their bearing on theories of heredity. He cited facts from his own observations and from the literature which cannot be explained by Weismann's theory of reduction of the chromosomes. He considers it necessary to assume, in some cases at least, a predetermination of the characters of the hybrid at the time of the fusion of the male and female nuclei. The male and female chromosomes probably persist side by side unchanged in number, and possibly unchanged in quality, during the whole of the ontogeny of the hybrid. It is also necessary to assume that the influence exerted during ontogeny of the hybrid by the material bearers of heredity is, at least in some cases, a function of their relative positions. Xenia is well established and, together with cases where the mother-plant influences the developing embryo, is inexplicable by most of the current theories of heredity, and necessitates the assumption that hereditary influences can be transported from cell to cell for some distance.

11. *Variable Reaction of Plants and Animals to Hydrocyanic Acid Gas*. MR. ALBERT F. WOODS, Department of Agriculture.

PLANTS of various families and in different stages of growth were subjected to varying amounts of hydrocyanic acid gas, and were found to be affected by it in different degrees, according to the kind of plant, its age, and other conditions of growth and development. Animals, mainly insects, were also found to vary, even within the same family, in like manner. Mites were the most resistant of any of the organisms studied, often recovering after several hours of complete paralysis and apparent death.

12. *Effect of Alternating Dryness and Moisture on the Germination of some Seeds*. MR. A. J. PIETERS, Department of Agriculture.

THE experiments recorded are preliminary to more extensive ones now in progress, but they show clearly that for some seeds germination is quickened by thorough drying after a long period of dampness. In most cases after a small percentage of germination for the first one hundred days or more, drying for two weeks followed by wetting resulted in a germination of from 15 to 54 per cent. in a few days. In the check pots, meanwhile, the seeds either did not germinate or only a small per cent. did so.

13. *Experiments on the Morphology of Arisæma triphyllum*. PROFESSOR G. F. ATKINSON, Cornell University.

THE author described his experiments by

which he had been able, by growing male and neuter plants of this species in rich soil, to change them to female plants, and by removing a part of the stored food supply of female plants to change them to male.

14. *On Polyembryony and its Morphology in Opuntia vulgaris, Mill.* DR. W. F. GANONG, Smith College.

THE author has found this species to be polyembryonic, with a double morphological basis; one set of embryos develops from a mass of tissue which he believes to arise from the fertilized egg-cell, while the other arises on the walls of the embryo-sac, but not from the nucellus, but probably from an endosperm cell, which, if true, is a new mode.

15. *Contributions to the Morphology and Biology of the Cactaceæ.* Part II., *The Comparative Morphology of the Embryos and Seedlings.* DR. W. F. GANONG, Smith College.

THIS paper is a continuation of the author's earlier studies on this family. It describes and figures germinated embryos of most of the genera and many important species, discusses germination and growth of the seedlings and the unfolding of the peculiar morphological features of the adults, together with the form, size and color factors of the embryos and seedlings, and what these show of importance for the determination of the phylogeny of the genera.

16. *The Morphological Significance of the Lodicules of Grasses.* DR. W. W. ROWLEE, Cornell University.

A STUDY of the flowers of Bamboos leads to the conclusion that the lodicules of grasses represent a reduced perianth. The three lodicules in *Arundinaria* alternate with the stamens, and may, therefore, be considered the inner whorl or petals. The stamens are directly opposite the midribs of the carpels, and indicate that the inner whorl of stamens, present in some bamboos, is suppressed in *Arundinaria.* Hackel interpreted the lodicules as distichous bracts.

17. *Observations on the American Squaw-root (Conopholis Americana, Wallr.).* DR. LUCY L. W. WILSON, Philadelphia.

THIS paper contained an exhaustive study of the vegetative characteristics of this parasite and of its relations to its invariable host, the Oak. Because of its extreme degradation and the intimacy of its relation with the host, the author compared it with members of the Balanophoreæ and Rafflesiaceæ rather than with parasitic Scropulariaceæ.

18. *Water Storage and Conduction in Senecio præcox, DC., from Mexico.* DR. JOHN W. HARSHBERGER, University of Pennsylvania.

THIS species, inhabiting volcanic beds in the Valley of Mexico, shows a remarkable method of storing water in the pith, and prevents its too rapid loss in the dry season by protective layers of cork and balsam. The water is conducted to the vegetative points by bundles which project into the pith. The histological characters are fully described.

19. *Notes on the Embryology of Potamogeton.* MR. K. M. WIEGAND, Cornell University.

THE author had studied the origin and development of the embryo-sac, fertilization and development of the embryo in this species. Although the normal number of cells is present in the egg-apparatus and the antipodals they form irregularly. Of particular interest is the fact that the definitive nucleus cuts off a very large basal nucleus, as in Sagittaria, before endosperm formation proceeds.

20. *Recent Experiments and Observations on Fruit-Production in Amphicarpæa.* DR. ADELINE SCHIVELY, Philadelphia Normal School.

THIS paper continues the author's recently published observations on this subject, and

she now shows that aërial flowers, when buried at any period before fertilization, produce the underground kind of fruit, and not the kind they would have produced in their normal position, from which the author draws conclusions as to the very powerful action of the environment upon seed production and structure in this species.

21. *On the Formation of Cork Tissue in Roots of the Rosaceæ.* DR. MARTHA BUNTING, Philadelphia High School.

THE author showed that intercellular spaces exist between the cork cells in all herbaceous and shrubby species of Rosaceæ examined by her, but these are absent in arborescent species; protoplasm, nuclei and starch grains exist in cork zones four to five layers removed from the phellogen.

22. *The Structure and Development of Internal Phloem in Gelsemium sempervirens, Ait.* MISS CAROLINE THOMPSON, University of Pennsylvania.

THE mode of formation of the internal phloem in the pith of this species, and the way in which it crowds out the pith in its growth, together with a remarkable arrangement of the bundles in the petiole, are fully described.

The officers for the ensuing year are: President, W. G. Farlow; Vice-Presidents, J. M. Macfarlane, G. F. Atkinson; Secretary-Treasurer, W. F. Ganong.

The next meeting of this Society will be held in December, 1898, in conjunction with the American Society of Naturalists and the Affiliated Societies.

W. F. GANONG,
Secretary.

REPORT OF THE COMMITTEE ON ANTARCTIC EXPLORATION.

AT the Philadelphia meeting of the American Society of Naturalists, held in December, 1895, a committee was appointed to inquire into the practicability and feasibility of the exploration of the Antarctic Continent. This committee made a report to the Society, which was published in the 'Records' of the meeting of 1896, and the committee was continued, with power to add to its number. The following report was received by the Secretary too late to be presented at the recent Ithaca meeting.

H. C. BUMPUS,
Secretary.

Your Committee on Antarctic Exploration respectfully report that they have further considered the subject-matter which was referred to them, but regret that they are still not in a position to give assuring indications as a result of their inquiries. The seeming impossibility of obtaining a suitable vessel and sailing crew in any of the southern South American ports, and the non-willingness of the Newfoundland fishing and whaling interests to associate themselves with so distant enterprises as would be involved in any form of Antarctic exploration, complicate the problem very materially, or, at least, set so high an estimate upon general costs as to make the realization of an expedition at a period of financial depression somewhat of an uncertainty. It has been found impossible to ascertain what form of assistance might be obtained from the Australian whaling fleets, but the letter which was addressed to your Committee by the late Baron Ferdinand von Müller intimates that little assistance of any kind should be relied upon to come from that quarter.

Your Committee have been in correspondence with Civil Engineer Robert E. Peary, relative to the subject of the inquiry, and have obtained through him valuable data bearing upon general costs and possibilities, notably in a series of estimates that were submitted to him by Mr. H. J. Bull, of Christiania, Norway, intended to cover one or more joint commercial (whaling) and scientific enterprises, and to yield a

profit to those undertaking the burden of schemes suggested. Mr. Bull is virtually the organizer of the cruise of the 'Antarctic' in the years 1894–95, when a landing was effected on the assumed Antarctic Continent at Cape Adare, and his opinions and estimates are deserving of respectful consideration. He confidently assumes that a joint commercial and scientific expedition could be arranged so as to render its outcome largely profitable to investors, even to the extent of £500 or more, and yet so directed as to place it mainly to the purposes of scientific investigation. In his various estimates, however, which cover the purchase of one or more suitable steamers, the absolute hiring of full officers and crews, the amount of capital required is so large, £9,000 to £14,000, as to render an association in this form of combined enterprise doubtfully desirable. Your Committee believe that an expenditure of $40,000 to $50,000, or perhaps even less, would suffice to construct an independent scientific expedition of its own, which would be in every way, if we may judge by past experience and results, to be preferred to an expedition whose associations must be largely commercial. Your Committee believe that independent subscriptions to the extent of $40,000 or $50,000 could be obtained at this time only with great and united effort, and yet it is by no means impossible that patrons of exploration may be found who would generously contribute to the fund of a properly organizing expedition. And it is almost certain that Arctic and Antarctic enterprises, despite the generous criticisms which are meted out to them in various quarters, will, for a long time, receive the favor of American good-will and protection. It seems very probable, also, that a selected number of scientific associations and institutions of general learning, such as universities and colleges, might be induced to coöperate to a common end, sending representatives to an expedition proportional to amounts of cash subscriptions.

Your Committee, if so desired, will be pleased to still further prosecute their inquiry. It is with satisfaction that they report the departure of the Belgian Antarctic Expedition under command of Lieutenant Gerlache, and with it the association of the American explorer, Dr. F. A. Cook, a prominent member of the Peary Expedition of 1891–92.

Respectfully submitted,

Angelo Heilprin.

Chairman Committee on Antarctic Exploration.

ELIZABETH THOMPSON SCIENCE FUND.

At a meeting of the Board of Trustees, held at Boston January 13, 1898, reports were read from the recipients of previous grants, and the record of the following grants was closed, the authors having published their investigations:

No. 54. Samuel H. Scudder, Esq., of Cambridge, Mass., $250, granted June 29, 1894, for a monograph on the caliptenoid series of North American Acridians. The publication is: 'Revision of the Orthopteran group Melanopli (Acridiidæ) with special reference to North American Forms.' *Proceedings U. S. National Museum,* Vol. XX., p. 1–421, Pl. I.–XXVI.

No. 64. Dr. Julius Elster and Dr. H. Geitel, Wolfenbüttel, Germany, $185, granted April 8, 1895, for photo-electric investigations with polarized light. The publication is: 'Ueber die Abhängigkeit des Photoelectrischen Stromes vom Einfallswinkel und der Schwingungsrichtung des erregenden Lichtes und seine Beziehung zu der Absorption des Lichtes an der Cathode.' Annalen der Phys. u. Chem. N. F., Bd. 61, p. 445–465.

The following new grants were made:

No. 72, $150 to Professor J. McK. Cattell, Garrison-on-Hudson, New York, for the Study of fatigue in relation to mental conditions. Application 737.

No. 73, $250 to Professor J. von Kennell, Dorpat, Russia, for a Monograph of the palæarctic Tarteicidæ. Application No. 742.

No. 74, $300 to Professor Georges Urbain, 1 Rue Victor Cousin, Paris, France, for the chemical investigation of rare earths. Application No. 746.

No. 75, $25 to Professor Wm. Z. Ripley, Massachusetts Institute of Technology, Boston, Mass., for a Bibliography of the Anthropology and Ethnology of Europe. Application No. 747.

No. 76, $300 to Professor A. Bélopolsky, Observatoire centrale, St. Petersburg, Russia, for Experiments on the Principle of Doppler-Fizeau. Application No. 749.

No. 77, $100 to Professor C. H. Eigenmann, Bloomington, Illinois, for the Study of Blind Fishes. Application No. 751.

No. 78, $250 to Professor P. Francotte, Rue Gillon 66, Brussels, Belgium, for the investigation of the fecundation and segmentation of the eggs of Polyclada. Application No. 755.

New applications will be considered in January, 1899, provided they are received by the Secretary before December 1, 1898. Circulars announcing the terms of the trust for the guidance of applicants may be obtained by application to the Secretary.

CHARLES SEDGWICK MINOT,
Secretary.

HARVARD MEDICAL SCHOOL,
BOSTON, MASS., January 22, 1898.

JOHN A. GANO.

MR. JOHN A. GANO, of Cincinnati, Ohio, who died on January 15th, should be remembered by Amerian scientists as the one who most efficiently encouraged the establishment of a system of daily weather predictions for the benefit of business men. This subject was suggested in my inaugural address, as Director of the Observatory, in May, 1868, and Mr. Gano, as one of the trustees, at once took the matter up for favorable action. On the 28th of July, I explained it more fully to him and, at his request, put my ideas in writing for his use as editor of the Cincinnati *Commercial.* In 1869 he became President of the Chamber of Commerce, and a second letter from me was requested by him, which gave him the desired opportunity to urge the matter upon the attention of that body. He appreciated the whole scope and bearing of the proposed work ; he appointed the Committee of Conference and in every way forwarded the enterprise with the greatest intelligence and discretion. After the 'Weather Bulletin of the Cincinnati Observatory' began to appear, September 1, 1869, he advocated a still wider extension of the work. I had already visited the Chicago Board of Trade and written to the daily papers of New York City, hoping to extend the scope of our work. In addition to this, Mr. Gano and Mr. William Hooper, as delegates to the National Board of Trade meeting at Richmond in November, 1869, contemplated bringing our work to the attention of that body, but when they found a scheme already formulated by my correspondent, Professor I. A. Lapham, and the Hon. H. E. Paine, of Milwaukee, and about to be presented by the Hon. C. D. Holton as delegate from the Milwaukee Board of Trade, they heartily supported that and on their return to Cincinnati assured me that they regarded a national weather bureau as the inevitable outcome of the work at Cincinnati.

The Cincinnati Weather Bulletin and predictions of 1869 was really my personal effort to utilize science for the benefit of the people, but historically it may also be considered as a revival of the reports and maps started by Espy and Henry, under the joint auspices of the Federal Government and the Smithsonian Institution, in 1848, and maintained at Washington with the coöperation of the various telegraph companies until 1861. Professor Espy was personally well known in Cincinnati, where he died in 1857. The merchants of that enterprising city had long been accustomed to secure special weather telegrams to guide them in their business operations, and every one responded to Mr. Gano's endorsement of the

idea of a local, and, eventually, a national work for the benefit of the whole community. Mr. Gano retained to the last his position as a delegate from Cincinnati to the annual meeting, at Washington, of the National Board of Trade, and it is but a few weeks since he was here to congratulate us on the extended usefulness of the Weather Bureau.

CLEVELAND ABBE.

WASHINGTON, January 17, 1898.

CURRENT NOTES ON PHYSIOGRAPHY.

TRANSVERSE ALPINE VALLEYS.

E. RITTER, of Geneva, assistant on the Geological Survey of France and author of special studies on the region of Mt. Blanc, presents the results of his researches on the origin of the location of water-courses, with special reference to the transverse rivers of the western Alps (Le Globe (Geneva), XXXVI., 1897). He discards the theory of an origin along faults, as advocated by Daubrée on the basis of experiments but without local confirmation, and announces a close relation between the transverse valleys and a number of 'orthogonal synclines' or transverse sags in the axes of the folds into which the strata of the region have been compressed. The depression of the sags amounts to 1,000 meters in some instances, as determined by measures of the altitudes of geological horizons. The Arc, Isère, Arve and Rhone are said by Ritter to be examples of transverse rivers thus located; these rivers would, therefore, be classed as transverse consequents. They gather many longitudinal branches from within the mountains, some of these being on synclines (longitudinal consequents), some on monoclines (longitudinal subsequents), and some on anticlines. For the latter it is suggested that a shallow syncline on the crest of the anticline may have served as of temporary guide, the stream having now cut down so deep that nothing but anticlinal structure is visible. Such an explanation hardly recognizes the generality of the problems involved. A river thus perched on an arch would soon be cut to pieces by the branches of its neighbors in the troughs, unless the core of the arch were weak enough to allow it to cut down its valley very rapidly; and in the latter case a valley would be spontaneously developed along the axis of the arch even if no shallow syncline had ever been formed on its crest. The anticlinal streams are, therefore, probably longitudinal subsequents, and the drainage as a whole is partly consequent upon surface deformation, partly adjusted to the internal structure.

PHYSICAL GEOGRAPHY OF NEW YORK.

THE second article under this heading, by R. S. Tarr, discusses the mountains of the State (Bull. Amer. Geogr. Soc., XXIX., 1897, 16–40), and brings clearly to light the strong contrasts of the several mountain groups there included. Especial attention is given to geological structure as affording explanation for differences of form, as such as prevail between the even-topped Highlands, the massive Adirondacks, the linear Alleghenies and the benched Catskills. It is to be feared that, from brevity of form, misapprehension may follow from the statement that, while the Himalayas and Alps are like the Appalachians in origin and rock structure, they are 'not sufficiently mature' to be like them in form; but 'given time, they will become so.' The reader can hardly avoid inferring from this statement that the simple continuation of destructive processes will, in time, transform the other mountain ranges into an Appalachian topography. Only by re-reading other parts of the article can it be understood that the Alps and Himalayas must pass to old age and then by elevation (and not by time alone) enter a new cycle,

in whose maturity their ridges may have even crests, like those of the Alleghenies. So a statement in an earlier paragraph, 'The Adirondacks rose as an insular land area in the earliest Paleozoic sea,' may unfortunately confirm the prevailing error that the Adirondacks were lifted out of water in the earliest Paleozoic sea, in spite of the preceding clause to the effect that they were first elevated in Archean time. The conclusion that the Adirondacks sank as an insular land in the Paleozoic sea is not presented.

PLATEAUS, TABLELANDS AND BASINS.

AN article on the Topography of Mexico, by H. M. Wilson, with a hypsometric map (Bull. Amer. Geogr. Soc., XXIX., 1897, 249–260), presents an account of the desert plains of the interior, including the following statement: "According to common belief, Central Mexico consists of a vast plateau. In fact, it is a great basin or depression, ribbed with many irregularly disposed or disconnected mountain ranges, buttes and isolated ridges, which are separated by broad valleys and plains. Many of these plains are the beds of ancient lakes, like those of Salt lake or Humboldt valley in Utah and Nevada, and have no drainage outlet to the sea" (p. 252). The objection here implied to the use of the term, plateau' is not valid, if a comparatively even surface at a considerable elevation is all that is required to make a plateau; for Mexico has plenty of that sort of surface; nor is the discontinuity of the plains a sufficient reason for placing them outside of the class of plateaus, inasmuch as many accepted plateaus are discontinuous, either from the addition of volcanic cones, the survival of residual mountains, or the excavation of canyons and valleys. Tableland or table mountain is an inappropriate name for an elevated region with still higher borders, although fitting for such great cliff-edged plateaus as those trenched by the Colorado canyon, or for such huge plateau remnants as Roraima and Kukenam, in Guiana. Mesa is limited to smaller examples of uplands with precipitous borders on one or all sides. Basin is already used too indefinitely; being applied to ocean basins, river basins and lake basins, as well as to these arid depressions, floored over with accumulating waste from their higher rims. Penck has lately introduced the German word *Wannen* to replace the indefinite *Becken*, for depressed areas with centripetal drainage. *Bolson* is a Spanish-American term quoted by Hill as locally applied to the intermont depressions of the Mexican region. The curious thing in all this is that English-speaking geographers have no simple name with which to designate this well characterized class of land forms.

W. M. DAVIS.

CURRENT NOTES ON ANTHROPOLOGY.

THE BLACK RACE.

A SUCCINCT exposition of the ethnography of the black race is given by Professor Hamy in *l'Anthropologie*, Vol. VIII., p. 257, sq.

It embraces one-tenth of the human species (about 150,000,000); and of this, one-tenth again (1,500,000) has existed outside of Africa, in Melanesia, etc., from a period when those numerous islands were part of the Asiatic continent.

In Africa, within five degrees north and south of the equator, is the territory of the dwarfs, probably once stretching nearly across the continent. North of this, on both sides of Lat. 15° north, and from the Nile to the Atlantic, are the groups of pure blacks, of average stature, nearly all agricultural, and with a knowledge of iron from a remote date. South of the dwarfs are the Bantu peoples, extending from ocean to ocean, with notable physical differences,

but united by identity of language. The Bushmen and Hottentots in the far south form a separate group, with individual characteristics. But the whole race is distinguished from others by the combination of a dark skin and crisped hair.

ETHNOGRAPHY OF TUNIS.

Few portions of northern Africa are as interesting for the historian and ethnographer as Tunisia. There Carthage was situated and extended her powerful sway far inland, and thither Homer leads Ulysses to find the lotos-eaters.

The most thorough student of its ethnography, both past and present, is Dr. L. Bertholon, of the city of Tunis. He has published a number of memoirs of marked value, notably a *résumé* of the anthropology of Tunisia (1896), and anthropological exploration of Khumidria and the island of Gerba, the latter being the scene of the Homeric lotophagi (*L' Anthropologie*, 1897).

In the *Revue Tunisienne* (October, 1897) he sums up the evidence to show the European origin of certain elements of the Berber population of north Africa, from the ancient race of Europe represented by the Cro Magnon type. In supporting this thesis he calls to his aid both the survivals of the type in the present population and the information contained in Egyptian inscriptions and classical writers.

THE CHULTUNES OF LABNA.

Labna is one of the ruined cities of Yucatan, and a *chultun* is the Maya name for a peculiar kind of chamber, constructed ten or fifteen feet below the surface and communicating with it through a well-like opening. They are common elsewhere in Yucatan and were described by the traveler Stephens in his familiar books. Some of them have finely polished, stuccoed sides, while others are roughly finished. Those at Labna are described with care by Mr. Edward H. Thompson in the 'Memoirs of Peabody Museum,' Vol. I., No. 3 (Cambridge, 1897).

By some they have been considered granaries, by others water reservoirs. Mr. Thompson found in many of them human bones, stone implements and pottery. Those remains he inclines to believe are not indicative of the original intention of the chambers, but were, for some obscure reason, placed in the reservoirs when their original purpose was abandoned.

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

At the recent meeting of the American Chemical Society in Washington attention was called to the fact that much of the best work now being done on atomic weight determinations is by American chemists. In this work Professor Richards, of Harvard, stands in the front rank, and his latest work is of great importance. In the Proceedings of the American Academy he has published, in connection with Mr. A. S. Cushman, a revision of the atomic weight of nickel, and, in connection with Mr. G. P. Baxter, a revision of the atomic weight of cobalt. The atomic weights of these two metals are of unusual interest, because, according to most determinations, that of cobalt is greater than that of nickel, while from its position in the periodic system the reverse would seem to be demanded. The late Professor Krüss attributed the discrepancy to impurities in the metals used by previous experimenters, and isolated from them what he supposed to be a new metal, 'gnomium,' whose existence has never been confirmed. Professor Richards' results are of decided comparative value, inasmuch as the same compound—the bromid—was used of both metals, and the analyses were carried out by exactly the same process. The metals were most carefully purified, but little variation was found

in the analysis of samples which had been purified to an extreme degree and those in which the purification had not been carried quite so far. Thus, no evidence was found showing the presence of any other element or any impurity in the nickel bromid and cobalt bromid used. The figure obtained for the atomic weight of nickel is 58.69, and for cobalt 58.99, and the results of former observations as to the anomalous order of these elements in the periodic system are confirmed. An explanation of the anomaly is not forthcoming, and the same may be said regarding the atomic weight of tellurium. Further work upon the atomic weights of nickel and cobalt involving the use of other compounds than the bromid are now in progress in the Harvard laboratory.

A RECENT number of the *Journal* of the Society of Arts contains an extended article by Thomas Bolas on arsenical poisoning by wall papers, etc. After pointing out that the work of Gasio and Emmerling has conclusively shown that certain moulds have the power of living on arsenical paper and forming volatile arsenic compounds, the author points out that arsenic even in small quantities is poisonous to these moulds and that the throwing off of arsenic in a volatile form may be an effort of nature to cast out the poison. Further, the most dangerous papers may be those which contain mere traces of arsenic, as when a large quantity is present the moulds themselves could not live. He suggests that traces of arsenic may come into wall papers from the imperfect washing of the vessels used to contain the more highly arsenical colors, and states that dyed and printed fabrics now very frequently contain traces of arsenic. He recommends the use of the precipitated borate of copper as a green pigment to replace arsenical greens, as long ago proposed by Bolley. In view of the present low price of boric acid, this pigment could be used commercially.

A NOTE in a recent number of the *Chemical News* by Percy A. E. Richards calls attention to the presence of zinc in a water which, after being stored in a reservoir, was conveyed to a private residence through a galvanized iron pipe some two miles long. The amount of zinc bicarbonate in the water was 7.3 parts per 100,000 or 73 milligrammes per liter. In the following number of the same journal Dr. T. L. Phipson makes note of the presence of zinc in a sample of water which was conveyed into the town of Funchal, island of Madeira, through galvanized iron pipes. Dr. Phipson remarks that, 'as zinc is a metal whose compounds have a noxious action upon the economy, it is evident that galvanized iron pipe cannot be used with safety to supply water for drinking.' It would seem probable that the large amount of zinc in the water described by Mr. Richards (more than half a grain in a pint) would have a decided effect upon the health, though zinc is probably far less injurious than several other metals occasionally present in drinking water. The distance the water was conveyed and the probability of its relatively slow passage through the pipes would account for the large quantity of zinc present.* Where only short lengths of galvanized iron pipe are used there would be far less danger, but the subject deserves further study.

Among recent articles on calcium carbid and acetylene is one by Lunge and Cedercreutz in the *Ztsch. Angew. Chemie* on their analysis. The gas from ordinary calcium carbid contains up to four per cent. of impurities; among them hydrogen sulfid and phosphin are the most important. These are very injurious, and the gas may be puri-

* An account of a very similar case to that reported by Mr. Richards is given in the London *Lancet* for March 1, 1884, as occurring in the water supply of the village of Cwmfelin, Wales.

fied from them by passing through a solution of bleaching powder, which readily oxidizes them. The amount of acetylene furnished per kilogram of commercial calcium carbid should be not less than three hundred liters. According to Fuchs and Schiff in the *Chemiker-Zeitung*, two samples of the Neuhaüser carbid gave, the one 286.8, and the other 297.6 liters per kilo.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

SURVEYS OF FOREST RESERVES.

IN response to a resolution adopted December 15th, the Secretary of the Interior has transmitted to the Senate a report, prepared by the Director of the U. S. Geological Survey, of the operations of the survey in carrying out those provisions of the last Sundry Civil Act which relate to the survey of the public lands which have been or may hereafter be designated as forest reserves.

The report goes into the subject of organization of the work under the several branches, the characters of the land to be surveyed, progress and results, etc. To the date of the report more or less work had been done in nine reserves—the Black Hills, the Big Horn, the Teton, the Uinta, the Bitterroot, the Priest River, the Washington, the Lewis and Clarke, and the Flathead. The work consists of (1) a topographic and subdivision survey, and (2) an economic examination of the forests of the areas. The surveys comprise base-line measurement, triangulation, detailed topography, including the sketching of all timber areas on the map, leveling and the placing of permanent bench-marks, and land subdivision surveys. The examination of the forests comprises the study of the distribution of forest areas and woodlands, the size and density of the timber, and the distribution of species, the ravages of forest fires, the extent of pasturage and its effects and the extent of timber already cut. The report shows that the progress made in the work as a whole was not as great as had been anticipated, this being especially true of the surveys, and also that a large proportion of the appropriation is still unexpended. There are two reasons why the progress has not been greater: first, the fact that the work was not started until very late in the season and was thus greatly hampered by storms and cold; and, second, the extremely rugged and density-timbered character of the country under survey. Professor Walcott reports in detail the progress made in the few weeks in which work was done. It is hoped, with the coöperation of Congress, to resume operations early in the spring and make a full season in these reserves.

W. F. M.

GENERAL.

THE Bruce gold medal of the Astronomical Society of the Pacific Coast has been awarded to Professor Simon Newcomb, of Washington, D. C., for his distinguished services to astronomy. This is the first award of the medal, to the establishment of which we some time since called attention.

REPRESENTATIVE WHEELER, of Alabama, has introduced a joint resolution to fill the vacancies in the Board of Regents of the Smithsonian Institution by the appointment of Mr. Alexander Graham Bell, to succeed Mr. Gardiner G. Hubbard, deceased, and the reappointment of Mr. John B. Henderson and Mr. Wm. Preston Johnston, whose terms expire January 26th.

M. WOLF succeeds M. Chatin as President of the Academy of Sciences, Paris, while M. Van Tieghem, the botanist, has been elected Vice-President in the place of M. Wolf.

AT its meeting on January 12th the American Academy of Arts and Sciences elected John M. Coulter, of Chicago, and Douglas H. Campbell, of Palo Alto, as Associate Fellows in the Section of Botany, and Elias Metschnikoff, of Paris, as Foreign Honorary Member in the Section of Zoology and Physiology.

A BANQUET in honor of Professor Virchow's fiftieth anniversary as a university teacher and as editor of the *Archiv für pathologische Anatomie* was given at Berlin on December 28th. Speeches were made on Professor Virchow's services as a teacher and man of science by Professors Waldeyer and Liebreich, and Professor Virchow replied.

THE memorial meeting in honor of the late

Gardiner Greene Hubbard was duly held in Washington on January 21st, in accordance with the arrangements that we had previously announced. Mr. Alexander Graham Bell presided, and addresses were made in behalf of the different institutions and scientific movements in connection with which Mr. Hubbard was prominent. The speakers were Surgeon-General George M. Sternburg; Professor S. P. Langley; President W. L. Wilson, of Washington and Lee University; President B. L. Whitman, of Columbian University; President D. C. Gilman, of Johns Hopkins University; Dr. Marcus Benjamin, Major J. W. Powell, Mr. A. W. R. Spofford and General A. W. Greely.

WE regret to record the following deaths among men of science: Professor Ernst Ludwig Taschenberg, known for his contributions to popular economic entomology on January 20th, at the age of seventy-nine years; Dr. Necker, Privatdocent in astronomy at Königsberg, who died at Cairo, as the result of an accident on December 23d, aged thirty years; and M. Ernst Bazin, inventor of the roller steamer, for which much has been claimed.

CABLEGRAMS to the daily papers report that the weather was extremely favorable for the various parties observing the total eclipse of the sun in India on January 22d. Fuller information must be awaited before any details can be given, but it is expected that the photographic results will be especially valuable.

THE German Association of Men of Science and Physicians will this year hold its annual meeting in Leipzig, under the presidency of Professor Waldeyer.

A LOCAL reception committee has been formed in Cambridge for the fourth International Congress of Zoology, which opens on August 23d, with Professor Newton as chairman and Mr. Adam Sedgwick as vice-chairman.

THE International Fishery Congress convened at Tampa, Fla., on January 19th, with delegates from nearly all the States and from several foreign countries in attendance. There were present a large number of men of science, and important papers were promised in the program. We hope to give, in a subsequent number, a report of the scientific work of the Congress.

THE following item from the Martinsburg *Democrat* should be of interest to the President of the United States and to Senator Elkins: "Between the hours of 8 and 9 o'clock on Tuesday night last, people residing in the neighborhood of King and Raleigh streets were startled by a war of words between George M. Bowers and his brother, John S. Bowers, who are not on amicable terms. The wordy contest soon resulted in a fisticuff, in which a severe wound was inflicted by George M. Bowers upon his brother, extending almost from ear to ear. So severe was the injury that the services of Dr. Morison were required to dress the wound, as the injured brother bled profusely. No arrests were made. This is the same gentleman who is a candidate for Fish Commissioner of the United States."

THE Committee of the French Chamber of Deputies appointed to consider the organization, at the Exposition of 1900, of a section for universities and high schools has reported, urgently recommending such a section, to be called 'Section of Science and Letters.'

THE Geological Society of London will this year award its medals and funds as follows: The Wollaston medal to Professor F. Zirkel; the Murchison medal and part of the fund to Mr. T. F. Jamieson; the Lyell medal and part of the fund to Dr. W. Waagen; the balance of the Wollaston fund to Mr. E. J. Garwood; the balance of the Murchison fund to Miss J. Donald; the balance of the Lyell fund to Mr. Henry Woods and Mr. W. H. Shrubsole; and a part of the balance of the Barlow-Jameson fund to Mr. E. Greenly.

AT a meeting of the managers of the Royal Institution, held on January 6th, Professor E. Ray Lankester was elected Fullerian professor of physiology in the place of Professor Waller. If nothing has interfered with the program Professor Lankester began on January 18th a course of eleven lectures at the Institution on the 'Simplest Living Things.' On January 20th Professor Dewar will deliver the first of a course of three lectures on the 'Halogen Group of Elements,' and on January 22d Professor Patrick Geddes began a course of three lectures on 'Cyprus.' The Friday even-

ing meetings of the members were to be resumed on January 21st, when Sir John Lubbock, Bart., M.P., delivered a discourse on 'Buds and Stipules.'

THE subjects and dates of the lectures to be given at the Teachers' College, New York, by Professors James and Shaler, of Harvard University, have now been arranged as follows: Professor James will lecture on 'The Gospel of Relaxation,' at 3:30 p. m., on January 28th, and Professor Shaler on 'The Use of the Environment in Education,' at noon on February 19th.

THE Scientific Society of Bridgeport, Conn., has been given a large collection of birds and cells gathered some time ago by Rev. Mr. Linsley.

IT is stated in the *Athenæum* that MM. H. Lachambre and A. Machuron are going to issue an illustrated account of the making and equipping of M. Andrée's balloon and of his first attempt to start in 1896, which was frustrated by bad weather, as well as of his actual disappearance into the unknown in 1897. The authors accompanied M. Andrée to Spitzbergen, the one in the former year, the other on the later occasion. The book, which contains a brief biography of M. Andrée, is to be published in England by Messrs. Constable. The same firm is to bring out Mr. Trevor Battye's new book, 'A Northern Highway of the Czar.'

MESSRS. A. & C. BLACK will publish the lectures given by Dr. D. H. Scott at University College, London, last year, under the title 'Studies in Fossil Botany.'

THE *American Journal of Pharmacy* has issued an appeal for subscriptions in the United States towards a fund for the erection of statues in Paris to M. Pelletier and M. Caventou, the discoverers of quinine and strychnine.

DR. ELLIOTT COUES has been offered a position on one of the committees of the forthcoming International Zoological Congress, and intends being present at Cambridge.

THE U. S. Civil Service Commission announces that an examination will be held on February 23, 1898, at Washington, D. C., and other places throughout the United States for the position of assistant microscopist in the Department of Agriculture. This examination will consist of a very light educational test, together with practical questions on the use of the microscope. The microscopical inspection service under the Department of Agriculture has been greatly extended, and vacancies are to be filled in sixteen different cities. Only women are eligible for this position.

THE American Geographical Society held its annual meeting on January 17th, at Chickering Hall, New York, when the following officers were elected by unanimous vote: Ex-Judge Charles P. Daly, President, to act for one year; Egbert L. Viele, Vice-President, to act until 1901; W. R. Jones, Treasurer, to act until 1899; Anton A. Raven, Recording Secretary, to act until 1901; L. Holbrook, M. K. Jessup, Gustav A. Kissell, John A. Haddon and Henry Paush. Rev. Dr. C. C. Tiffany presided over the meeting. Forty-eight new members were elected, bringing the membership up to 1,187. The committee appointed to consider the erection of a new building reported that, while the present building at No. 11 West 29th Street is too small, the funds of the Society would not permit of the erection of a new building at the present time.

UNSUCCESSFUL attempts have been made in St. Louis and in Milwaukee to repeat the operation of total exsection of the stomach, successfully carried out by Dr. Schlatter.

THE bubonic plague continues unabated in India; influenza is epidemic in London, and there has been a serious outbreak of typhoid fever in Philadelphia, due, it is thought, to the breaking of a sewer and the emptying of its contents into the water supply of the city.

THE St. Petersburg Institute of Experimental Medicine held its annual meeting on December 20th, at which an address on the bubonic plague was delivered by M. Wladimiroff, and a report was presented by the Director of the Institute, Dr. Lukjanoff. It was stated that 120 persons had been engaged in research at the Institute, and that sixty-five investigations had been published. Three hundred and sixty-three persons had been treated for hydrophobia by antirabic inoculations, with a mortality of 0.7 per cent. and 25,000 tubes of anti-diphtheria serum had been supplied.

As we have already announced, the ninth

International Congress of Hygiene and Demography will be held at Madrid from April 10th to April 19th. The hygienic work of the Congress will be divided among ten sections, as follows: Microbiology in Relation to Hygiene; Prophylaxis and Transmissible Disease; Medical Climatology and Topography; Urban Hygiene; Hygiene of Alimentation; Hygiene of Infancy and of Schools; Hygiene of Exercise and Labor; Military and Naval Hygiene; Veterinary Hygiene, Civil and Military; Sanitary Architecture and Engineering. The part of the work relating to Demography will be divided among three sections, as follows: Technics of Demographic Statistics; Statistical Results in Relation to Demography; Dynamical Demography (movements of population, etc). The Secretary-General of the Congress is Dr. Amalio Gimenoy Cabañas, professor of hygiene in the University of Madrid, and the President of the Executive Committee is Professor Julian Calleia.

THE want of an independent water supply for the Zoological Gardens of London has been felt for many years by this institution, and recently it was decided to put down an artesian bored tube well. The results have been, as was anticipated, the tapping of powerful springs of pure water in the chalk at the depth of 450 feet, yielding 240,000 gallons per day.

A DEPARTMENT for hydrophobia—similar to the Pasteur Institute in Paris—is to be added to the Institute for Infectious Diseases in Berlin, of which Robert Koch is Director.

A DISPATCH to the daily papers from Montreal states that Mr. McCreary, the Immigration Commissioner, has taken over the herd of buffaloes which Lord Strathcona has presented to the Dominion government, to be placed in the National Park at Banff. There are seventeen animals in the herd, all thoroughbreds but one. The herd will be kept at Silver Heights, Lord Strathcona's estate, near Winnipeg, until April, when they will be sent to Banff, where they will be placed in an enclosure of forty acres, now being prepared for them.

BEFORE the members of the Drawing Room at the Waldorf-Astoria, Professor Willis L. Moore, Chief of the U. S. Weather Bureau, recently delivered a lecture, in which, according to report in the New York *Tribune*, he pointed out that the practical application of science to the industry of the world was nowhere more fitly illustrated than in the extensive and various uses made of the present weather service of the United States. Briefly referring to some of the more striking instances of the Bureau's utility, its Chief showed that the great raisin interests of California cured their fruit according to the weather reports, and nearly all the important vineyards were in telephonic communication with some central point from which forecasts of rain were distributed. On the high plains of Montana, Colorado and the western slope, Mr. Moore continued, the vast cattle interests herded their flocks on the first warning of a coming blizzard, and hundreds of cattle were annually saved by reason of the forewarning of the greater number of destructive cold waves. On the Great Lakes the destruction of life and property was but a small percentage of what it was fifteen years ago, due to the fact that to-day the mariners were students of the weather map, and the warnings of the Weather Bureau accurately foretold nearly all storms destructive to commerce.

A TABLE has been prepared by Rev. C. T. Ward, of New York, showing the amount of money left for benevolent purposes by testators throughout the united States during the past three years. The bequests amounted to $14,374,800 in 1897, $13,112,300 in 1896 and $9,401,500 in 1895. The money bequeathed for educational purposes last year amounted to $5,292,200.

PROFESSOR W. L. ELKIN, Director of the Observatory of Yale University, in his annual report for the year 1896–7, states that while in Europe in 1896 he purchased a third Voigtländer lens and one by Hermagis, both of six inches aperture, and since his return has procured two other similar ones of American make, thus making six cameras available on the mounting. The cost of all three of the Voigtländer lenses has been generously defrayed by Cyprian S. Brainerd, Esq. Five lenses were put in use in August last and eight meteor trails, five of them Perseids, were secured. The

November and December periods were, however, unproductive this year. Dr. Elkin has employed a considerable part of his time in the measurement and discussion of the photographic trails of the Perseids thus secured, now numbering 17 in all. So far, the results are not very conclusive as to the character of the radiant, but as each year will add to the data there seems good reason to hope ultimately for most valuable deductions. Mr. John E. Lewis has rendered valuable cooperation in this work, though he did not secure any trails at Ansonia. During the winter a portion of the work on the parallaxes of the ten first magnitude stars in the northern hemisphere, comprising the observations and reductions, was passed through the press. Dr. Chase was absent in Europe on leave from July, 1896, to January, 1897. Since his return he has taken up the Heliometer work on the parallaxes of large proper motion stars. During his absence the time service was under the care of Mr. George K. Lawton until October, 1896, and subsequently under that of Dr. B. W. McFarland. Dr. Palmer has been engaged in computations, mainly of refraction corrections and tables therefor. Miss Newton has been occupied in preparing a series of references to other catalogues in an interleaved copy of the Bonn Durchmusterung.

MR. T. WHITBURN, the President of the Guildford Natural History and Microscopical Society, writes to the London *Times* to say that on August 23d he addressed a letter to the African explorer and naturalist, Mr. F. C. Selous (who has a residence and museum near Guildford), informing him of the proposed petition for the preservation of Wolmer, and requesting his support. He also inquired if Mr. Selous would join the Society as an honorary member. The reply of Mr. Selous is as follows: "Allan Line Royal Mail Steamers.—Steamship Laurentian, Dec. 11, 1897.—Dear Sir.—I have been away in the Rocky Mountains, and only received your kind letter of August 23d the other day, on my return to Canada, on my way home. Although I have killed a great many wild animals, I have never destroyed life wantonly, and I think that I can fairly claim to be more of a naturalist than a sportsman. Besides having secured some very fine specimens of African big game for the South Kensington and South African Museums, I have also made large collections of butterflies and beetles (amongst which were many new species), all of which are now in the South African Museum at Cape Town. I trust that your Society will be successful in securing Wolmer Forest as a sanctuary for wild birds and animals, and I shall be very pleased to have my name added to your requisition. I shall also consider it a great honor to be made an honorary member of your Society, and will try and get in touch with you as soon as I come to live at Worplesdon, as I shall do sooner or later. Believe me, dear sir, yours very truly, F. C. SELOUS."

ACCORDING to the *Electrical World*, the value of the instruments and machinery during 1897 for scientific purposes exported from the United States was $3,054,453, which was an increase of half a million dollars as compared with the exports in 1896.

A GENERAL meeting of the Aëronautical Society of Great Britain, at which Sir Charles Warren presided, was held in the rooms of the Society of Arts on December 16th, when several forms of flying machines were exhibited and described. The report in the London *Times* states that Major Moore showed a machine in which he aims at reproducing the motions of a bird in flight, and Mr. S. Bruce explained how his signalling balloons might be found useful to Arctic explorers. The application of kites to the preservation of life was illustrated by the apparatus of Captain Spiers, who considers that the simplest way of carrying a line from a wrecked ship to the land is by means of a kite. Captain Baden-Powell, the Secretary of the Society, exhibited a specimen of the kites he employs for man-lifting purposes. He said that as a rule four or five kites 12 feet long were sufficient to lift a man, though in a very strong wind he had been raised off his feet by one. In America kites had been used for meteorological purposes, and experiments had been made with them for military purposes. He thought it a pity they had not been employed in the operations in India. Mr. Pilcher showed one of his soaring machines in which

he had been able to cover nearly 300 yards. He is now at work on a four-horse power oil engine, to weigh about 40 pounds, which he intends to fit together with a five-foot screw propeller to one of these machines; he hopes then to have a genuine flying machine. Captain Baden-Powell described an aluminum balloon, fitted with a Daimler oil-motor, which had recently been tried at Berlin with somewhat qualified success, and after a few remarks from the chairman on the military aspects of flying machines, the proceedings terminated with a vote of thanks to those who had brought forward exhibits.

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT HARPER says in his twenty-first quarterly statement that it is the custom of the Board of Trustees to arrange for the expenditures of a particular year six months before the beginning of that year. In accordance with this custom the Trustees, on December 29th, voted the budget for the year beginning July 1, 1898. The assured income of the University from all sources was estimated at $529,000. In addition to this amount the founder of the University, Mr. Rockefeller, has been kind enough to designate, under certain conditions, the sum of $200-000, making in all $729,000. The expenditures of the various divisions of the University and of the various departments have been adjusted to this estimated income. The sum of $25,000 has been set apart as a contingent fund and the remainder is distributed as follows:

Administration and General Expenses, ..	$72,875
Faculty of Arts, Literature and Science,	347,767
The Divinity School, ...	49,516
The Morgan Park Academy, ...	37,120
University Extension Division, ...	41,064
Libraries, Laboratories and Museums, ..	44,615
Printing and Publishing, ...	41,560
Physical Culture, ...	7,500
Affiliated Work, ...	3,000
Buildings and Grounds, ...	59,425

THE number of graduate students in arts and science in several leading universities are given by the *Harvard Graduates' Magazine* as follows: Harvard, 268; Yale, 254; Johns Hopkins, 220, and Columbia, 207. The number at Chicago appears from President Harper's recent statement to be larger than in any other American university, namely, 324, of which 202 are men and 122 are women.

DURING the present winter semester the registration of regular students in Berlin University amounts to 5,921. This is the largest registration in ths history of the University, being 400 in excess of last winter.

PROFESSOR JAMES E. RUSSELL, of the department of Education in the Teachers' College, New York, has been appointed Dean of the College and will, with Dr. F. S. Baker, of the department of English, represent the College on the Council of Columbia University.

THE Academy of Sciences, Paris, has recommended M. C. Chatelier, professor of chemistry in the School of Mines, and M. Joannis, lecturer at the Sorbonne, as candidates for the chair of mineralogical chemistry in the Collège de France, vacant by the death of M. Schützenberger.

M. GUIART has been given charge of the practical work in natural history under the Faculty of Medicine in the University of Paris.

MR. ALFRED HOPKINS, Q.C., M.P., has been elected Principal of Owens College, Manchester, in succession to Dr. Ward, resigned. Mr. Hopkins has announced his attention of retiring from Parliament.

DR. JULIUS ISTVÁNFFY has been appointed professor of botany in the University of Klausenburg, and Dr. Alexander Mágocsy-Dietz associate professor of botany in the University of Budapest. Dr. Ambronn and Dr. Rhumbler, docents in astronomy and zoology in the University of Göttingen, have been promoted to professorships. M. Benard has been appointed assistant in physics at the Collège de France, succeeding M. Maurain.

DISCUSSION AND CORRESPONDENCE.

CLIMATIC CONTRASTS ALONG THE OROYA RAILWAY.

TO THE EDITOR OF SCIENCE: Much has been written concerning the wonderful engineering necessary in order to construct the Oroya Railway, and concerning the scenery along its line, and every one is more or less

familiar with the main facts in the history of this, 'the highest railway in the world.' There is, however, one feature which the traveller who makes the trip from Lima to Oroya, over this wonderful road, cannot fail to notice, and yet which has scarcely been noticed in previous accounts. This concerns the climatic contrasts that are exhibited between the beginning of the line at Callao and its terminus at Oroya, 12,178 feet above sea level. The writer was so struck with these climatic changes during a recent trip over the railroad that he is tempted to send a hurried note concerning them to SCIENCE.

There is nowhere else in the world an opportunity like that permanently afforded by the Oroya Railway of travelling from sea level to an altitude of nearly 16,000 feet in eight hours in a comfortable railway carriage. Many tourists make the great mistake of going only part of the distance to Oroya, and they thus lose some of the most striking features in the climatic belts through which the road passes. Starting from sea level at Callao, the road runs through Lima up the fertile valley of the Rimac, where sugar cane and cotton growing on all sides recall the sugar and cotton plantations of our own Southern States, and bear witness to the genial climatic conditions which here prevail. The contrast, in this section, between the dry and barren hills above the valley and the fertile valley bottom itself, where the lack of rainfall is made up for by irrigation, is most striking.

Chosica, 2,800 feet above sea level, is the point at which the railroad was left and mules were taken in making the ascent of Mt. Harvard, occupied by Professor S. I. Bailey and his party in 1890 as a temporary station, before Arequipa was selected as the permanent site of the Southern Station of the Harvard College Observatory. Mt. Harvard, 6,600 feet above sea level, situated midway between the belt occupied by the 'coast cloud' and a cloudy and rainy region further inland, offered favorable opportunities for astronomical work, but was replaced by Arequipa, where the conditions are still more favorable.

Further up the line, at San Bartholomé, 4,959 feet in elevation, there comes a small belt of country where sugar cane and cotton no longer grow, but where fruit trees thrive. Bananas, apricots, limes, *chirimoyas*, *paltas* and other fruits are offered for sale in great quantities at this station, and are also sent down to the Lima market. San Bartholomé is also known —in this case unfavorably—as the chief seat of the disease known as *verrugas*, which, although not yet carefully studied in this region in connection with its dependence upon meteorological conditions, would seem, according to information given the writer, to be closely related to these conditions. *Verrugas*, which appears to be a species of blood poisoning, is usually less fatal to the natives of the region than to foreigners. During the construction of the railroad at this point a special hospital had to be built to accommodate the engineers and laborers, who fell victims to the disease. *Verrugas* is generally believed by the natives here to be milder and less prevalent in years when there are few cloudbursts, and more common and more severe in years of many cloudbursts. The disease is always most prevalent after the rainy season has begun.

In this region some rain is said to fall every year on the mountains, but the annual rainfall is reported to be very small, indeed, until above Matucana (7,788 ft.), where the increasing elevation provokes increased precipitation. Cloudbursts, or *huaicos*, as they are here called, occur anywhere on the mountains, at intervals of a few or of many years. These *huaicos*, which seem to be similar in every way to the cloudbursts of our southwestern country, do great damage to the railroad line, especially to the bridges and embankments across the (usually) dry ravines, or *quebradas*. They come very suddenly, and bring down great quantities of rocks and sand from the mountain sides. It was a *huaico* of this kind that carried away the famous Verrugas bridge a few years ago. Landslides are not uncommon in connection with the *huaicos*. A rainy season here comes from December to April. At Casapalca (13,606 ft.) the rain falls mostly in the afternoon, and snow, when it falls, comes usually late in the afternoon. The rain is said to begin earlier and earlier in the day as the rainy season comes on, this apparently being the result of the increasing activity of convectional

ascent as the sun comes more nearly over this parallel of latitude. There is a common belief at Casapalca that there is less snowfall at that town than in former years, and a greater number of *huaicos*, but this, if true, is undoubtedly only another case of a periodic change in climatic conditions, which may last a few years and will then be followed by some years of the reversed conditions.

Mention has been made of the change from the sugar and cotton belt to the fruit belt. In ascending the valley from San Bartholomé the fruit district is soon left behind, and the San Mateo (10,534 ft.) is the center of a region singularly adapted to the growth of potatoes. Here the mountain sides are covered with terraces, most of them built in very ancient times, and potatoes are grown to considerable altitudes above the valley bottom. The increasing rainfall in this region results in a considerable growth of grass and some low shrubs on the mountain sides, whereas nearer the sea level, as above noted, the slopes are bare, and farther up the snow lies on the mountain summits throughout the year. On his journey over the Oroya the writer encountered the first rain noted during the trip at 3 p. m., at an altitude of about 13,000 feet above sea level, and another shower came at 4 p. m., at an altitude of over 14,000 feet.

At the Galera Tunnel, 15,665 feet, the highest point reached by any railroad in the world, considerable snow fields were seen at about the same height above the sea as that of the tunnel, and isolated patches of snow were met with somewhat below that elevation. At this point any cultivation of the ground is, of course, out of the question. From the Galera the descent is rapid down the grass-covered slopes of the mountain into the valley in which Oroya is situated, and here again we reach a climatic zone where it is possible to raise potatoes and other farm products. One can thus travel by the Oroya Railway from fields of sugar-cane and cotton, through a belt where fruit grows most luxuriantly, and up higher to a district famous for its potatoes, until, after winding around slopes and through tunnels, at an altitude where nothing but grass grows, the snow line is reached, and a descent is made to a region where the rigorous climate of 16,000 feet is replaced by those more genial conditions which favor the raising of crops. This whole succession of climates can be passed through in the short space of ten hours, and it is this feature of the Oroya road which it seems to the writer has not been sufficiently emphasized. The climatic lesson which such a trip teaches is one which is well worth learning, even at the risk of a touch of *soroche*, or mountain sickness, which comparatively few persons escape at the highest part of the road.

A rather interesting industry, which was distinctly the result of climatic conditions, was attempted a few years ago in connection with the snow fields on the mountains above Lima. The presence of these large masses of snow and ice in close proximity to the railroad led to the adoption of a scheme to transport these products of the climate to Lima, where they were to be sold to the inhabitants as ice is sold in our own country. A beginning was made, and some ice was thus taken to the city, but there were certain legal and pecuniary complications in the way, and the enterprise had to be abandoned. A reminder of this unsuccessful venture is still to be seen on the list of freight rates from Oroya to Lima, posted at the railway station in Oroya. On this list, together with the rates for the transportation of freight of various kinds, the traveller may see how much it costs to send *snow* from Oroyo to the capital. In Quito the sale of snow and ice brought to the city by the Indians from the high mountains in the vicinity furnishes a similar illustration of the climatic control over human occupations, one of the most important, as it is one of the most striking, subdivisions of the subject of anthropo-climatology.

The climatic contrasts which are exhibited along the Oroya afford an excellent illustration of the variety of climates found in Peru by reason of its high mountains and its geographical position. We learn from Prescott that the Incas were well aware of the differences in the climates of various parts of Peru, and that they were careful to study the climatic conditions to which the tribes they conquered had been accustomed. In transferring, as was often their custom, newly-conquered subjects from their

own district to some other portion of the empire, the Incas made it a point never to oblige people accustomed to a high altitude to live at sea-level, nor to make those who were used to living at a low altitude live far above sea-level. In every case the transfers were made to districts where the climatic conditions were as nearly as possible the same as those to which the conquered people had become accustomed. One of the most interesting contrasts in the climates of Peru is seen in the difference between the desert costal strip of the provinces bordering on the Pacific and the forested Amazonian provinces in the northeast. In the former the dry climate prevents vegetable growth, except where man has provided irrigation, and there must be a constant struggle against Nature in order that anything green may grow. In the well-watered Amazonian provinces, on the other hand, vegetation is altogether too abundant, and man must here struggle to keep down what Nature produces too freely. In fact, the exuberance of the vegetation is such as to interfere with the habitability of the region, for almost as soon as a clearing is made in the forests it is again overgrown. In the rainy provinces, therefore, habitability is almost precluded by the superabundance of vegetation, while in the barren desert strip man can only live where his own labor has provided a water supply sufficient for the needs of vegetation. The contrast is a striking one.

R. DeC. Ward.

Lima, Peru, December 27, 1897.

AN INTERESTING MONSTROSITY.

My attention was recently called to the monstrosity pictured in the enclosed photograph. It is a cock, of no pure breed, though carrying some Plymouth Rock blood, having no signs of spurs upon the tarsi, but with well developed ones upon the head, on either side of the comb, just above the eyes. These spurs, neither of which is quite normal in shape, are symmetrically placed, and have every appearance of horns. The right spur, which is less malformed than its mate, is fifteen-sixteenths of an inch in length from its perforation of the skin, and about three-sixteenths of an inch at that point, tapering somewhat unequally to a blunted point, the whole curved so as to somewhat resemble the horn of a Texas steer.

The left spur, which in diameter and length would be nearly identical with the right, is bent forward so as to form a nearly complete circle, approximately one-half inch in diameter, the point of the spur being in contact with the base of the comb. Both of the spurs are entirely disconnected with the bony structure of the skull, being attached only to the skin and easily movable in all directions.

I could not ascertain from the owner of the cock, in whose possession it had been but a short time, whether this looseness of attachment was congenital or had been brought about by contact with the coop or by fighting.

What makes this specimen extremely interesting is the fact that it is neither a case of dichotomy nor of supernumerary parts nor of atavism, but one in which the normal part is found in an abnormal position without any vestige of representation in its usual place.

In the limited amount of material at my command, I have been unable to find any accounts of cases in many respects similar to this, although Sutton, in his 'Evolution and Disease' (Contemporary Science Series), mentions the successful transplanting (artificially) of the spurs of cocks to the excised comb. I am awaiting with interest the result of interbreeding this specimen, in the hope that more of its peculiar kind may be secured, from which a fertile variety of monstrosities may be obtained.

Edwin G. Dexter.

Colorado State Normal School,
Greeley, Col.

CORRECTION.

Objection having been made to my use of the term 'respiration' in the article 'Some Considerations upon the Functions of Stomata' in Science, January 7, 1898, page 15, second column, line 12, I wish to substitute for it the expression 'the passage of gases.' Plant physiologists, for very good reasons, wish to restrict 'respiration' to the gaseous exchange which has to do with the catabolic activities of living cells, excluding that exchange taking place in those anabolic activities (known as photosyntax)

by which the plant makes use of carbon dioxide in building up carbohydrates.

CHARLES E. BESSEY.

SCIENTIFIC LITERATURE.

U. S. Geological Survey. Monograph XVIII. The Marquette Iron-bearing District of Michigan, with Atlas. By CHARLES RICHARD VAN HISE and WILLIAM SHIRLEY BAYLEY. Including a chapter on the Republic Trough by HENRY LLOYD SMYTH. 4to. Pp. xxi + 608. Pl. I.–XXXV. Figs. 1–27. Atlas sheets I.–XXXIX. Price, $5.75.

The issue of the above monograph marks the completion of another chapter in the investigation of the ancient crystalline rocks of America. The book presents the fullest solution yet attained of one of the most puzzling and elusive of the many problems confronting geologists. The great economic importance of the region early drew attention to it. First the copper excitement and then the development of the iron interests brought settlers in increasing numbers. The pioneer work of Foster and Whitney established the claims of the rocks upon the attention of geologists, and the long and honorable line of investigators who have devoted time and effort to the understanding of them embraces the names of many of the best workers in this branch of science.

The monograph opens with a preliminary abstract of its contents, in which a reader who cannot well peruse all its pages will find a succinct exposition of what follows. A brief introduction then outlines the larger official reports previously issued, the area to be described, the chief geological classification, the distribution of the principal formations and the broad structural features. In Chapter I., W. S. Bayley presents a thorough bibliography of all previous literature in the shape of abstracts of each paper or reports chronologically arranged. This has been a heavy task, for the literature is extensive (the chapter occupying 148 pages), and the cited articles are difficult ones to sum up concisely. Dr. Bayley has, however, done so not only concisely, but with great clearness and thoroughness. In Chapter II. the same writer discusses the Basement Complex. Much light is thrown on this tangle of metamorphosed eruptives, but no unwarranted hopes of unravel ing their stratigraphical relations are encouraged. The Northern Complex is treated under the following subdivisions: The Mona schists, the Kitchi schists, the gneissoid granites, the hornblende-syenite and the intrusives. The Southern Complex is subdivided into the schists, both micaceous and hornblendic, the gneissoid granites, the Palmer gneisses and the intrusives. A few isolated areas are cited within the boundaries of the Algonkian.

In Chapter III., C. R. Van Hise takes up the description of the Lower Marquette series in detail. The Algonkian rocks form a compressed syncline on the whole, with many minor foldings along axes both parallel to the main axis and at right angles with it. The whole series pitch downward to the west, so that as one goes in this direction later and later strata are encountered. The basal formation is the Mesnard quartzite, marking the advance of the sea from the eastward. It also appears to some extent around the northern and southern sides on the east. It is succeeded by the Kona dolomite, the Wewe slate, the Ajibik quartzite; the Siamo slate and the Negaunee formation of sideritic cherts, ferruginous slates, ferruginous cherts, jaspilite and iron ores. The last named is the stratum of the greatest economic interest, as it contains the chief deposits of ores. The derivation of the latter from the cherty carbonates in troughs of some impervious rock, by the replacement of the chert, is well established and is a further application of views already presented for the simpler Penokee-Gogebic district. A stratigraphical break occurs between the Lower and Upper Marquette series.

In Chapter VI., Professor Van Hise treats of the Upper Marquette series. The Upper Marquette begins with the Ishpeming formation, which is subdivided into the Goodrich quartzite and the Bijiki schists. Considerable ore bodies are in the base of the Goodrich quartzite, produced by the erosion of those in the Negaunee formation below, but they are treated under the Negaunee formation, as they are closely associated with it. Above the Ishpeming lies the Michigamme of slates and graywackes, mica-schists and mica-gneisses. Next follows the Clarksburg of effusive basic lavas

and fragmental volcanics, with occasional sediments interbedded. The Clarksburg formation is described by Dr. Bayley, who also, in Chapter V., discusses the various intrusive rocks that preceded the Clarksburg and those that follow it. In Chapter VI., H. L. Smyth describes in detail the interesting trough that runs off from the main Marquette syncline to the Republic mine. While the general relations are much like the large area, there are present of the Lower Marquette series only the Ajibik quartzite and the Negaunee iron-bearing formations, and of the Upper Marquette only the Goodrich quartzite and the Michigamme mica-schist. Minor peculiarities in local geology are also met. In Chapter VII., C. R. Van Hise gives a broad, general, structural discussion of the whole area. The monograph is illustrated by many plates and figures. The former include beautiful, colored reproductions of the rocks of the Negaunee formation that are associated with the iron-ores. An atlas of maps also accompanies the letterpress. Besides a general map there are thirty-five sheets of quarter townships, four inches to the mile.

The entire work is a monument to its authors and of incomparable interest alike to students of metamorphism, of economic geology and of structural geology. The mining operators of the region should find it a suggestive guide in new developments and exploratory work. The book is written in a clear and pleasing style which deserves commendation no less than does the scientific matter. J. F. KEMP.

The Phase Rule. By WILDER D. BANCROFT. Ithaca, N. Y., The Journal of Physical Chemistry. Large 8vo. Pp. viii+255. Paper. With numerous diagrams. Price, $3.00.

This interesting volume presents the subject of qualitative equilibrium of heterogeneous substances, on the basis of Gibbs' 'phase rule' and Le Chatelier's theorem. Mathematical theory, electro-chemistry and quantitative equilibrium are not discussed, but diverse phenomena in great variety, including the temperature, pressure and concentration of components are coördinated as examples of a few general principles. The general scope of the work can best be illustrated by a few subjects, selected from the many experimental data brought under review.

Water in an open vessel is not usually in a state of equilibrium, since evaporation takes place at the surface, and the liquid gradually diminishes in quantity. When the vapor is confined, in a limited space, its mass increases at any given temperature, until it exerts a certain definite pressure upon the surface of the water, and equilibrium results. With any change of temperature, some new pressure will be found before equilibrium is established; and if rectangular coördinates are used to represent the varying temperatures and pressures, some curved line will contain all the points which express conditions of equilibrium. Here is a system consisting of a single component in two phases, and the conditions of equilibrium are expressed graphically by a line. A definite change of either temperature or pressure or the density of water or vapor requires some definite change in another condition also. In this sense the conditions of equilibrium have but one degree of freedom, and the system is *monovariant.* Now, let the water be cooled until it begins to freeze. This implies a fixed temperature (0° C.) and a fixed vapor pressure of about 4.6 millimeters of mercury. If the system includes all three phases it is said to be *nonvariant*, and the conditions are represented by a single point in the diagram. At lower temperature the liquid will all freeze; at higher temperature the ice will melt. With increased pressure at zero all the vapor will be condensed; with diminished pressure all the liquid will gradually vaporize; in either case the system is reduced to two phases. A second curve of pressure can be drawn for ice in contact with vapor, and a third for ice in contact with liquid water, either system of two phases being *monovariant.*

When a salt, as potassium chloride, is added to the system in excess, there are two components, with the possibility of four phases; with the further addition of potassium nitrate, there are three components and may be five phases. In each case, if all components are present in the solid state, together with the saturated solution of all and the superincumbent vapor, the conditions of temperature, pressure and

concentration are all fixed ; a change in any one of these conditions results in the elimination of one phase ; or, if both temperature and pressure are made to change arbitrarily, equilibrium cannot be restored without the loss of two phases from the system. When two kinds of change may thus be made at pleasure, the system is said to be *divariant* and to have two degrees of freedom. It is here assumed that any disturbing effects due to gravity, electricity, capillarity or the distortion of solid masses are avoided, pressure and temperature being uniform throughout the system. The absolute and relative masses of the several phases have no effect upon equilibrium, except as some phase disappears entirely. The number of independent variables (including temperature and pressure) is two more than the number of components; and Gibbs' phase rule asserts that in the equilibrium of heterogeneous substances the number of degrees of freedom is equal to two more than the number of components, diminished by the number of phases. Thus, a non-saturated solution of a salt, in contact with vapor, may be altered at pleasure in regard to the concentration of the salt and either the temperature or the pressure; with two components in two phases, two arbitrary changes are subject to the will of the operator.

Le Chatelier's theorem asserts that "any change in the factors of equilibrium from outside is followed by a reverse change within the system." Thus, if a small amount of salt be added to the non-saturated solution, without change of temperature, this increase of concentration is offset in part by condensation of vapor and the pressure is therefore diminished. The system tends to return to its former condition of equilibrium by elimination of the disturbing element. Thus the sense of change resulting from the disturbance from conditions of equilibrium can be predicted, but the amount or rate of change involves quantitative relations which lie beyond the scope of the volume under review.

Experimental data are discussed, as indicated above, with regard to systems of one, two, three and four components. The relations of temperature, pressure and concentration are represented graphically. Much ingenuity has been shown in devising triangular diagrams to represent the relative masses of three substances by coördinates on a single plane. Melting and boiling points, critical temperature, allotropy, cryohydrates, solubility of anhydrous and hydrated salts, double salts, efflorescence, dissociation, supersaturation, volatile solutes, partially miscible liquids, eutectic mixtures and temperatures, fractional distillation, solid solutions, occlusion, alloys and fractional crystallization are among the subjects discussed, with numerous concrete examples.

The author's distinction between solvent and solute, or between solubility curve and fusion curve (as on pp. 36, 45, 95, etc.), does not find general acceptance. An attempt to determine the 'hypothetical line' of demarkation (page 158) may help to decide the point at issue.

While physical chemistry is rapidly gaining importance, many are deterred by the mathematical difficulties. To such, this work will give a welcome clew to the import of differential equations. Students of physical chemistry will here find a considerable field brought under review and duly systematized. Numerous indications are given of the present limitations of science and the open fields for profitable investigation.

ROBT. B. WARDER.

The Principles of Mathematical Chemistry; The Energetics of Chemical Phenomena. By DR. GEORG HELM. Authorized Translation by J. LIVINGSTONE R. MORGAN, PH. D. New York John Wiley & Sons; London, Chapman & Hall, Limited. 1897. 12mo. Pp. viii+228. Price, $1.50.

The original German edition has been recognized for three years or more as a work of value, and this translation will doubtless find a welcome. The principles of thermodynamics (including the conservation of energy) are asumed as the basis for the discussion. The intensity and quantity factors are distinguished in the various forms of energy, and the principle of constant or increasing entropy is applied to various reversible and non-reversible changes. Equations for chemical intensity are applied to electrolysis, simple chemical reactions, chemical equilibrium, freezing and boiling

points, vapor pressures, osmotic pressure, diffusion, speed of chemical reaction and to the phase rule.

Robt. B. Warder.

Observation on the Coloration of Insects. By Brunner von Wattenwyl. Translated by Edward J. Bles, B.Sc., King's College, Cambridge. Leipsic, Engelmann. Fol. Pp. viii + 16. 9 plates.

In 1873, and again ten years later, Brunner published essays on 'hypertely,' or extravagance in nature, which are practically the foundation of the present work, in which an attempt is made to classify the fundamental phenomena of coloration in insects. These are treated of under the headings of uniform coloration, stripes and spots, the line of orientation ('indicating the position assumed by the insect in receiving its coloration'), strokes and dots, eyespots, spirals, splash marks, cloudings, stencil patterns, erosion, changes in pattern, enlargement or diminution of spots and bands, discoloration, diminution of patterns, changes due to adaptation, staining of contiguous parts, fading in covered parts, coloring in relation to position, and finally, as the summation of the whole, the arbitrariness of coloration. One quotation from the section on stencil patterns may be given as a good sample of his illustrations:

"In *Pseudocreobotra ocellata* Serv. one sees on the transparent, somewhat yellowish ground of the fore wings, firstly, a green patch, laid on as with a stencil. Then, in the middle of the green portion, opaque, citron yellow is laid on in the form of a spiral. The spiral is bordered with a heavy black line and in the center of the spiral there is a round spot of the same color.

"The black line obviously is meant to serve as a setting of the yellow spiral, yet careful examination reveals that the black marking is bodily shifted slightly inwards towards the insertion of the wing. For on this side, between the yellow spiral and the black line, a narrow strip of the green ground shows, while on the outer side the black border plainly encroaches upon the yellow ring. The shifting of the black marking is still more plainly shown by the small central spot not lying where it obviously should lie, but likewise shifted inwards.

"We have, consequently, three colors stencilled on the glassy wings: first green, then lemon yellow, and to complete the picture, a black body color; the latter is somewhat misfitted, as it may also be at times in our colored prints.

"I wish to lay stress on the agreement in this arrangement amongst all the many specimens which have passed through my hands. The idea can, therefore, not be entertained that the negligence described is a mere chance occurrence in one individual. The species was ornamented *once for all*, and just as it emerged from this operation, so has it been transmitted by inheritance."

He further mentions, in his final division, the case of an Acridian of the genus *Mastax*, in which a yellow stripe on the sides of the body includes the lower third of the facetted eyes, "and, as the stripe is formed by a body pigment, there is no doubt that the power of vision is destroyed in the part affected."

The author concludes that "the careless splashings, the defective stencil patterns or the impairment of vision by a band laid over the eyes and many other facts met with in the study of coloration cannot be brought into relation with any purposeful tendency. If one, therefore, calls modification through natural selection, Darwinism, a new name [Brunnerism?] must be introduced for the undoubtedly demonstrable occurrence of phenomena in the whole living world which have no relation to their owners or are occasionally harmful to them and hence are certainly not the result of selection."

Brunner combats the possibility of any gradual assumption of the more striking features, including the phenomena of mimicry, and, therefore, contends that they cannot be the result of natural selection; but he formulates no new law or process by which they can be presumed to have come into being, and so is forced to conclude that in the coloration of insects "we meet with an *arbitrariness* striving to produce attributes without regard for their possessors, and, therefore, obviously to be looked

upon as the emanation of a Will existing above the universe." This can hardly be looked upon as a compliment to the Deity.

The work is published in two editions (German and English), and is accompanied by nine exquisite plates, with 144 colored figures.

It is not a little curious that throughout the work the English translator uniformly uses 'colour' and 'coloured,' but 'coloration.' Is this to meet Americans half-way?

SOCIETIES AND ACADEMIES.

MEETING OF THE OHIO STATE ACADEMY OF SCIENCE.

THE seventh annual meeting of the Ohio State Academy of Science was held at the Ohio State University, Columbus, Ohio, on December 28 and 29, 1897, Dr. W. A. Kellerman, of Columbus, presiding. The meeting was well attended and much interest was manifested. The Society now numbers about two hundred, twenty names being presented for membership at this meeting.

The first paper, by R. J. Webb, was on 'The Fertilization of the Closed Gentian.'

Dr. D. S. Kellicott reported on Additions to the Odonato of Ohio. The list of dragon-flies for the State now numbers ninety-seven.

E. W. Vickers gave three short papers on 'The Pileated Woodpecker in Mahoning County,' 'Pickering's Hylodes in Ohio' and 'The Least Weasel in Ohio.'

Edo Claassen reported briefly on the following subjects: 'Occurrence of the Long-leaved Willow,' 'Abnormalities in Plants,' 'List of Liverworts of Cuyahoga and other Counties of Northern Ohio,' 'List of Plants New to the Flora of Ohio' and 'Erratic Boulders in the Valley of Rocky River.'

Dr. W. A. Kellerman gave the President's address on the subject: 'Does Modern Science furnish an Adequate Philosophy of Human Life?' and besides reported on the 'Distribution of the Green Ash in Ohio,' '*Ustilago reiliana*, Spermatophyta rare or new to the Ohio Flora' and 'Revision of the Catalogue of Ohio Plants.'

Professor F. M. Webster spoke on Some additions to the known insect fauna of Ohio.

R. C. Osburn and E. B. Williamson gave a description of a new species of fish, *Etheostama sciotense Osburn* and *Williamson*, a full description of which will appear in the Proceedings of the Society. They also gave a list of 69 species of fish for Franklin county, Ohio, and a list of the Crayfish of Ohio.

J. H. Shaffner read papers on 'Atavism in *Citrullus vulgaris*,' 'Notes on the Salt Marsh Plants of Northern Kansas' and 'Observations on the nutation of *Helianthus annuus*.'

Other papers were:

Notes on the Pleistocene geology in the vicinity of Devil's Lake, Wis., and dynamical modifications of quartzite: J. A. BOWNOCKER.

Science for the first year of the high school course, and Additions to the list of Ohio Fungi: F. L. STEVENS.

Science in the country school: E. E. MASTERMAN.

Cell-division in the Pine: E. L. FULLMER.

Embryology of a dicotyl: MISS L. C. RIDDLE.

Dissection of a double Trillium: MRS. W. A. KELLERMAN.

Additions to the list of plants of Ohio; Reversion of leaves to laments in tick-trefoil, and Evidence as to the origin of the islands of Lake Erie: E. L. MOSELEY.

The junction of the blue and yellow clays in the drift of northern Ohio, and recent beaches at Sandusky Bay and Sodus Bay: A. A. WRIGHT.

A list of the butterflies of Ohio (ninety-seven in number): J. S. HINE.

The Jonathan Creek drainage basin: H. J. DAVIS.

The preglacial drainage of Knox county: W. G. TIGHT.

Preglacial drainage in the vicinity of Cincinnati; The Ohio River a result of glacial conditions, and No evidence of an ice dam at Cincinnati: GERARD FOWKE.

Some new points on fin attachment of Dinichthys and Cladodus: WM. CLARK.

Four critical points in the valley of the Cuyahoga River: E. W. CLAYPOLE.

The following officers were elected for the ensuing year:

President—W. G. Tight, Granville.

Vice-Presidents—Josua Lindahl, Cincinnati; J. H. Todd, Wooster.

Secretary—E. L. Moseley, Sandusky.

Treasurer—D. S. Kellicott, Columbus.

Executive Committee—Mary E. Hart, Oxford; E. W. Vickers, Ellsworth.

Member of Publication Committee—Dr. S. Belle Craver, Toledo.

RAYMOND OSBURN,
Press Reporter.

THE WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS.

THE Academy held its 28th annual meeting at Milwaukee, December 27th–29th. The following were the principal scientific papers presented:

Reports of officers and other general business, 9:00 to 9:30 o'clock.

Reading of papers, 9:30 o'clock.

'Report on the progress of the Geological and Natural History Survey of Wisconsin,' Professor C. Dwight Marsh, President of the Academy, and Professor E. A. Birge, Director of the Survey.

'The Fresh-water Sponges of St. Louis Bay,' Mr. N. A. Harvey.

'The Relation of Motives to Freedom,' Professor E. H. Merrell.

'The Duration of School Attendance in Chicago and Milwaukee,' Professor Daniel Fulcomer.

'On the Meaning and Function of Thought-connective,' Professor E. T. Owen.

'The Psychology of the Sense of Injury,' W. F. Becker, M.D.

'The Succession-period of Generations,' Professor Chas. H. Chandler.

'On the Relation of Joints to the Forces which produce them,' Professor C. R. Van Hise.

'The Origin of Conglomerates,' Professor G. L. Collie.

'Notes on the Itasca Basin,' Mr. F. E. Lurton.

'On a plan to gather Information Concerning Wisconsin Diamonds,' Professor Wm. H. Hobbs.

'Recent Investigations to Determine the Relation of Crystal Forms to Chemical Composition,' Professor Wm. H. Hobbs.

'Observations of Nature and People in Eastern Siberia,' Isidor Ladoff.

'Observations on the Nocturnal Flight of Migrating Birds,' Dr. O. G. Libby.

'Unsteady Motion in Capillary Tubes,' Mr. H. C. Wolff.

'Theoretical Investigation of Motion of Groundwaters,' Professor C. S. Slichter.

'Pressures within a Heterogeneous Spheroid,' Professor C. S. Slichter.

'Recent Developments in the Electro-magnetic Theory of Light,' J. E. Davies.

'The Action of Dilute Solutions of Electrolytes on the Sense of Taste,' Dr. Louis Kahlenberg.

'Several Nitrogen addition products of Caryophyllene,' Professor Edward Kremers.

'A New Model of the Lobule of the Lung,' Professor W. S. Miller.

'A Study of the Variation in the Bileducts of the Cat,' Professor W. S. Miller.

In regard to the State Survey, Professor Marsh referred to the fact that $5.000 had been appropriated by the Legislature for each of two years, which was sufficient to pay the actual expenses incurred, while Professor Birge gave his services as Director free. Mr. E. R. Buckley is preparing a report on building stone, and Mr. Samuel Weidman on the geology of the vicinity of Merrill. Seven bulletins will be published during the coming year by the Survey, but that rate of publication cannot be maintained on the present revenne, since the Commission is availing itself of a large amount of work already done by individuals.

Professor Van Hise spoke at some length, following Professor Slichter's second paper, which the latter had worked out in response to geological queries. Professor Van Hise gave it as his conviction that vulcanism and the increasing heterogeneity of the earth had been by far the greater causes of the folding of the strata, and that computations concerned with the secular cooling of the earth were of slight value from a geological point of view.

A. S. FLINT.
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 477th meeting was held Saturday evening, January 8th.

Mr. J. E. Watkins presented a paper on 'The Transportation and Lifting of Heavy Bodies by the Ancient Engineers.' The purpose of the paper was to show how many of the structures regarded as remarkable by expert engineers of the present day, and which some archæologists declare must have required in their erection the use of immense machines, could have been constructed by primitive tools and simple methods.

By means of diagrams the speaker explained how inclined planes of earth, etc., could be used in placing in position stone blocks or slabs of enormous weight, levels and pry-bars being

employed in setting them up. He then demonstrated how easily, comparatively speaking, the Pyramids could have been constructed by these simple methods, and when completed the earth around them which had been used for the inclined planes filled into the pits from which it was taken, leaving the ground as level as before.

As an illustration the Pyramid of Gizeh was cited, some of the stones of which were transported a distance of five hundred miles. In this case the highest embankment necessary when the workmen reached the top course, assuming that a 20% grade was adopted, would have been 750 yards long, containing, as it did, some seven and a half million cubic yards, provided the sides of the embankment would stand at an angle of 30°, which is not at all improbable. A force of ten thousand men could have built such an embankment in a single twelvemonth, a very small part of the total labor which it is stated called for the services of one hundred thousand men for twenty years.

In the solution of the problem of putting in place huge monoliths it was suggested that the modern engineer could well consider the utilization of inclined planes before adopting a more complex method.

The second paper was by Dr. T. J. J. See, of the Lowell Observatory, on 'Recent Discoveries of Double Stars in the Southern Hemisphere.' He recalled the climatic studies which led Mr. Lowell to locate the Observatory at Flagstaff, Arizona, and stated that what is needed now is not better telescopes, but better atmosphere. Since August, 1, 1896, he has been engaged on an extensive campaign for the discovery and measurement of double stars. Some 100,000 stars between —15° and —45° of declination had been examined and about 1,000 systems measured. He announced that he had forwarded to the *Astronomical Journal* a catalogue of 500 new double stars, many of which are of the highest interest.

The third paper was by Mr. C. D. Walcott, on the United States Forestry Reserve, which will be published in full in the *Popular Science Monthly.*

E. D. PRESTON,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the meeting of the Geological Society, of Washington, held on January 12, 1898, Mr. C. Whitman Cross, of the United States Geological Survey, read a paper on 'The Geological *vs.* the Petrographical Classification of Rocks.' This paper was an argument in favor of distinguishing between the systematic classification of rocks as concrete objects, in accordance with which they are described and named, *i. e.*, the petrographical classification, and the geological classifications necessary from several points of view. Many of the latter arrangements, such as that expressing genetic relationships of igneous rocks, are based on theory or hypothesis and produce instability if introduced into the systematic classification. It was urged that neither geological occurrence nor genetic relations should be used in sub-classification of igneous rocks. This paper will soon be published in full in the *Journal of Geology,* Chicago.

Arthur C. Spencer read a paper on 'The Upper Cretaceous Section in Southwestern Colorado.' For the purposes of geological mapping in southern Colorado it has been found necessary to subdivide the Upper Cretaceous section in a manner differing from that of common usage in the Rocky Mountain area. The Dakota occurs with its usual characters. Above it comes a series of shales, known to embrace the Benton, Niobrara and a part of the Pierre, which cannot be divided on lithologic grounds. The fossil-bearing layers are not persistent or numerous enough to serve as guides in areal mapping.

The upper part of the section has not received detailed examination. It consists of massive sandstones in which both the Fox Hills equivalent and that of the Laramie may prove to be present. This sandstone is overlain by the Animas beds, which are probably equivalent to the Denver beds of the Denver Basin.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the evening of January 3, 1898, nineteen persons present, the following officers for 1898 were installed: President, Edmund

A. Engler; Vice-Presidents, Robert Moore and D. S. H. Smith; Recording Secretary, William Trelease; Corresponding Secretary, Joseph Grindon; Treasurer, Enno Sander; Librarian, Gustav Hambach; Curators, Gustav Hambach, Julius Hurter; Directors, M. H. Post, Amand Ravold.

Dr. Amand Ravold spoke informally of formaldehyde gas as a disinfectant, and exhibited several forms of apparatus adapted to its use. It was stated that, although in confined spaces the gas has proved an effective disinfectant, which has the merit of not injuring the most delicate fabrics or polished metal surfaces, its germicide action in dwelling rooms has thus far proved less satisfactory than that of sulphur dioxide and chlorine, so far as it has been tested by the Health Department of the City of St. Louis; so that, as yet, the Health Department has not found it possible to employ it as a substitute for the older and in some respects more objectionable disinfectants.

Two persons were proposed for active membership in the Academy.

WILLIAM TRELEASE.

SCIENTIFIC JOURNALS.

The American Geologist, January. Several important changes are to be adopted by this journal during the coming year. Professor N. H. WINCHELL is now the editor-in-chief, and there are eleven associate editors. A new department has been added, which is not covered by any other geological journal. This is a monthly authors' catalogue of American geological literature. Besides forming a part of the regular magazine, it is proposed to issue this catalogue on separate sheets for the benefit of librarians and investigators. The undertaking seems a very commendable one, and will form a valuable index. In the present number G. K. GILBERT gives a sketch of the life and works of the late Joseph F. James, with a portrait. N. H. WINCHELL elucidates the determination of the feldspars in a manner which will be found of much service to petrologists. The Pittsburg Coal Bed, one of the richest mineral deposits in the eastern United States, is described by I. C. WHITE, in respect to its age, area and structure. The drilling for petroleum has shown that the coal area belonging to this bed is much smaller than has been estimated. The reviews of recent geological literature, personal and scientific news, and correspondence, are a feature of the magazine as heretofore.

American Chemical Journal, January. 'On Salts of Nitroparaffins and Acylated Derivatives of Hydroxylamine,' L. W. JONES. 'The Action of the Halogenes on the Aliphatic Amines and the Preparation of their Perhalides,' J. F. NORRIS: A comparison of the action of bromide and iodine and the formation of a number of perhalides containing one or more halides. 'On Acyl Imido Esters,' H. L. WHEELER, P. T. WALDEN and H. F. METCALF. 'Notes on Double Salts of the Analides, with Cuprous Chloride and Cuprous Bromide,' W. J. COMSTOCK.

J. ELLIOTT GILPIN.

NEW BOOKS.

Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbeltiere. ALBERT OPPEL. Jena, Gustav Fischer. 1897. 2d part. Pp. viii+682. M. 20.

Die Farnkräuter der Erde. H. CHRIST. Jena, Gustav Fischer. 1897. Pp. xii+388. M. 12.

L'électro Chimie. AD. MINET. Paris, Gauthier Villars et Fils. 1897. Pp. 167. 2 fr. 50 c.

Transactions of the Congress of American Physicians and Surgeons, 4th Triennial Session. New Haven, Conn., Published by the Congress. Pp. liv+310.

Ethnological Studies Among the Northwest Central Greenland Aborigines. WALTER E. ROTH. Brisbane and London, Government Printer. 1897. Pp. xvi+199 and 23 plates.

Dissection of the Ophidian. DAVID S. KELLICOTT. Columbus, O. 1898. Pp. 72.

The Psychology of Suggestion. BORIS SIDIS. With an introduction by WILLIAM JAMES. New York, D. Appleton & Co. 1898. Pp. x + 386. $1.75.

Evolutional Ethics and Animal Psychology. E. P. EVANS. New York, D. Appleton & Co. 1898. Pp. 386. $1.75.

SCIENCE

FRIDAY, FEBRUARY 4, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE BIOLOGICAL PROBLEMS OF TO-DAY.**

Paleontological Problems. PROFESSOR HENRY F. OSBORN, Columbia University.

THE chief paleontological problems of the present day are involved in the phylogeny of the Mammalia, for upon this depend both Embryology and Comparative Anatomy, as well as Paleontology. The last decade has been one of a rapid succession of brilliant discoveries in South America and in southern Africa, and of a very great expansion of our knowledge of the North American fauna, together with some single discoveries of great importance, chief among which is the discovery of the foot structure of *Psittacotherium* by Wortman, leading to his exposition of the order Ganodonta as ancestral to the Edentata. Of great interest also is the hypothesis recently advanced by Matthew, that *Mixodectes*, of the Basal Eocene, is the ancestor of the Rodentia, instead of being connected with the Primates, as Cope supposed.

As regards the South American forms they are mainly important as revealing the existence of a new life center upon a continental scale; as tending to demonstrate a continental union between South America and Australia, and as exhibiting Marsupials which are more nearly allied to Placentals than any hitherto known. As Lydekker

*Discussion before the annual meeting of the American Society of Naturalists held at Ithaca, N. Y., December 28, 1897.

and Scott, on paleontological grounds, and Hatcher, on geological grounds, have demonstrated, this fauna is by no means of the great antiquity assigned to it by Ameghino. It is rathern modern and specialized than central and ancestral. The sources of this fauna should be sought possibly in an overflow of primitive Marsupials from Australia or elsewhere, and partly in an early emigration of Condylartha from North America. The latter may have constituted the origin of the Litopterna, but they give us no light upon the Toxodontia. At the same time the general principle of North American origin is strongly reinforced by the demonstrated relationship of the Ganodonta to the Edentata.

As regards the remaining Ungulates of the world, the origin of the Proboscidia and Hyracoidea is still wholly unknown. The Sirenia also remain without known ancestors. The group of *Ancylopoda*, proposed by Cope for *Chalicotherium* and other clawed forms with the bodily proportions of the Sloths, but many essential skeletal structures of the Perissodactyls, loses its distinctness from the Perissodactyl phylum, because of the discovery that *Agriochoerus* besides *Diplobune*, both undoubted Artiodactyls, exhibit a very marked parallel specialization of hoofs into claws. Going further back to the Lower Eocene there still exists a break between the Artiodactyla and Perissodactyla and any of the known forms of Condylarthra, for none of the latter are as yet proved to be directly ancestral to the even or odd-toed Ungulates. The Amblypoda stand apart as a very ancient and distinct phylum, geologically the oldest, and in structure the most archaic of all Ungulates; they should include the *Periptychidæ* and thus embrace the whole range of amblypods from the small arboreal Periptychids to the huge clumsy Uintatheres.

The most primitive type of Condylarth (*Euprotogonia*) and of Amblypod (*Pantolambda*), as recently studied by Osborn and Matthew, strongly reinforces the hypothesis first enunciated by Cope, *that the source of the Ungulata is to be found in the Creodonta.* Upon the other side of the great Mammalian tree, the numerous branches of Unguiculates or primitive clawed types also have converged towards a Creodont ancestry, as seen especially in the characters of the Ganodonta, or ancestral edentates, and of the Rodentia, if Matthew's supposition proves to be correct; also of the Tillodontia. Thus all these groups should probably be added to the Carnivora as Creodont derivatives. The Carnivora extend back into Creodont prototypes; but, as in the case of the Artiodactyla and Perissodactyla, the actual points of contact or links between these two divisions are yet to be discovered. So, again, with the Primates. Recent embryological evidence has tended to separate the Lemuroid and Anthropoid phyla. Hubrecht is confirmed by others in placing *Tarsius* near the parting of these phyla (although not in his separation of this genus from the Lemurs), and he makes a very radical break between Lemurs and monkeys upon grounds of placentation. The point of contact of the Primates with the Creodonta is still entirely wanting, but their relations appear to be here rather than with the Insectivora.

In spite, therefore, of the many remaining deficiencies or absence of links in our paleontological evidence, it has none the less come about *that the Creodont type takes the central position which was assigned by Huxley in 1880 to the Insectivora,* for the known Creodonta are more generalized and more central than any other of the known Insectivora, fossil or living, the known Insectivora showing a very considerable specialization, especially in their dental succession, which places them apart as a distinct side phylum. This does not affect the derivation of the Creodonta themselves from stem forms of unspecialized Insectivora existing in

the Jurassic period, the characters of which are very largely seen in the *Insectivora Primitiva*, or placentals of the Stonesfield Slate and Purbeck periods.

The discoveries in South Africa above alluded to take us back to the still older period of the origin of the Mammalia. Two of the types of the Theromorphs of the Permian and Lower Triassic, namely, the *Theriodontia* and *Gomphodontia*, supply many of the characters which we have expected to find in the ancestry of the Mammals. In fact, they embrace the few osteological characters placed in Haeckel's Promammalia, or Huxley's Hypotheria, as well as the more numerous characters which we have subsequently put into the Mammalian archetype. The *Theriodontia* resemble in their dentition and structure the minute *Protodonta* described by Osborn from the Triassic, but differ in the compound character of the jawbones as well as in their surpassing size. In tooth structure they are also prototypes of the *Triconodonta* or Marsupials of the Jurassic period. On the other hand, the herbivorous *Gomphodontia*, including *Tritylodon*, are prototypes of the great phylum of Multituberculata, which in turn, upon extremely slender evidence however, have been associated with the Monotremata.

Thus while the phylogeny of the Mammalia is still in a highly incomplete, speculative and shifting condition, if compared with the evidence we could have mustered ten years ago, it marks a prodigious advance and is full of stimulus for the immediate future of paleontology.

Botany. PROFESSOR WM. TRELEASE, Missouri Botanical Garden, St. Louis, Mo.

THOUGH for a time I found opportunity for work along ecological lines, necessity has compelled me to confine my study, of recent years, so closely to descriptive botany that at first I felt some hesitancy in accepting the invitation to open this discussion of the biological problems and proposed methods for their solution, in botany. But, on second thought, I decided that I might, without impropriety, do so, since I recalled the statement, heard many years ago on this campus, that the ultimate systematic arrangement of living things will be at once an epitome of all that is known of them and a key to their entire history; and I fully recognize that many of the most serious problems confronting the descriptive naturalist to-day are to receive their solution through increased knowledge of the things studied as living things. In point of fact, the great problem for the botanist and zoologist, the problem underlying and running through all others, is the problem of life.

I have seen so many vital phenomena explained by normal, if complex, physical laws that I may be pardoned, I trust, if at the outset I state that I look at this problem as a physicist and not as a vitalist, feeling that, with each added physical demonstration given, the improbability of an extraphysical answer to each unanswered question becomes in an even greater degree unlikely.

That which the botanist and zoologist are primarily concerned with is protoplasm. In general essentials alike in animal and plant, yet in detail differing in two individuals of the same species, in the twin offspring of the same parent, in different organs of the same organism, and seemingly in the same living cell at different periods, differentiated so that, at least in the vegetable kingdom, the morphological unit, the cell, is yet a complex organism, this substance represents apparently a most complex and ever-changing mixture of most complex and unstable organic compounds.

Though the animal possesses a higher specialization and a greater corresponding differentiation of its cells, and though those

which are exposed, or upon which much devolves, are here bound together by a wonderfully developed class of nerve cells, along which, from the center of sensation, travels an impulse which, through terminal dendrites, may establish and re-establish itself in that wonderful phenomenon which we call memory, and though the metabolic processes connected with the maintenance of animal temperature and with nerve structure and nerve action are more complex and less differentiable than in the vegetable kingdom, so that the plant is frequently turned to for an illustration of simple cell action; the green cell performs that added function of photosynthetically recombining the elements of simple unassimilable compounds into assimilable organic compounds, which by specialized structures are converted into organized substance, which again, by the action of secreted enzymes, is digested and fitted for transportation to points where it may be wanted for use, while these same compounds are still further synthetized by the incorporation of nitrogen, for the most part in relatively simple organic combination, so that it is by no means certain that the simplest field for the study of protoplasmic activity is afforded by the plant. Here, then, in the nutritive changes induced by and occurring in this delicately balanced vehicle of vital manifestations, lies the seat of one great problem: Is life life, or is it an attribute of matter? Does the synthesis of organic matter stop with the formation of the vegetable carbohydrate or the vegetable reserve proteid, or does the one pass into the other, which in its turn grades into the living protoplasm of the cell, the molecules of which, during active life, undergo continuous mutations and shifting combinations from the nutrient to the living and from the living to the excreted form? A part of this question has been answered. What shall be the answer to the other part? and if physical, what is to be said as to a positive suspension of protoplasmic activity, amounting to functional death, and of a revivification of protoplasm which actually has been dead?

One must concede that in plants, as in animals, death inevitably comes, sooner or later—unless one chooses to juggle with terms in an effort to prove that the unicellular organism, the individual cambium cell and the like are immortal. But in what does it consist?

In medicine a system of pathology has been worked out by which the theory and practice of a generation ago have become the science and art of to-day. For plants a science of pathology just as complicated, just as useful for the preservation of the life of the individual, remains to be worked out. Does disease cause 'loss of vitality,' or is this merely an expression of imperfect nutrition or clogging by waste products? What is anæsthesia? Is it a temporary reduction of vitality in certain cells, or an enveloping of their molecules by the inhibiting agent or its derivatives?

What is reproduction? What is heredity? The vehicle of each, as of every other vital phenomenon, is protoplasm; more, it is known that nuclein is directly concerned in the reproductive processes, and the technique of to-day has enabled it to be shown, for plants as for animals, that certain parts of certain cells unite. The physical or visible basis for a theory of the transmission of characters is more nearly reached to-day than ever before, but is the real essence of the problem any nearer elucidation? Why does the fertilized gamete of the alga produce a seaweed, and of the phanerogam a flowering plant? Why does the meristem of the oak produce oak leaves on all branches?

An analysis and subanalysis, to the last degree, of all of those phenomena which we call vital, and a chain of experiments elim-

inating successively each of the factors which can affect any vital process, can alone give answer. We may not live to see it, but perhaps it is not impossible that, though not a spontaneous generation of organisms, a planned generation of living matter may be effected under the eye of the experimenter.

Of the grosser directly biologic problems facing the botanist, none is more simple in appearance, nor apparently more difficult of solution, than that attending the rise of crude sap from the root to the leaf of one of the higher plants. Purely physical in the wonderful osmotic action of the absorbent cells, and purely physical in the evaporative action of the foliage, the flow of sap has a middle part to which the laws of physics elsewhere have not been fitted; and yet this conduction in the main is carried on through tissues which are dead. Here, too, the isolation, one by one, of all disturbing possibilities offers the only control of experiments from which final conclusions are to be drawn.

The plant has not a nerve system. It is true that its protoplasm communicates from cell to cell through all of the living parts, but no differentiated chain of corpuscles exists for the transmission of sensation, or whatever else you choose to call it, from organ to organ, much less from operative organs to a central control organ; and yet there are plants which are called irritable or sensitive; organs which, if touched, coil about a support—clasp, for digestive purposes, prey; leaves which, for protective purposes, drop into an inconspicuous position, or into a position exposing them less to the heat of the mid-day sun or radiation into the cold of night. These movements are said to be reactions to stimuli, manifestations of protoplasmic irritability; but those who have looked deepest into them find the difficulties of explaining the exact process multiplied the further they go. Division of the problem, division of labor, experimentation and observation under conditions most favorable for the normal growth of the plant, are the means of reaching a solution.

We owe it chiefly to Darwin that a science of ecology has sprung into life. The German school would call it biology, but it is not precisely what is immediately considered here as biology. It is the interrelations between living things and between them and their surroundings. All that, with loose expression of teleological purpose, would be called 'adaptation' belongs here. Many facts are well known. The theories advanced for their explanation often seem to explain them, but the theories concerning their origin are not always so satisfactory. Who can say that with more knowledge we may not discard even the most fundamental of them? Observation and differential experimentation are here means to the end, no less than elsewhere. How do plants react to their surroundings in nature—under cultivation? How have their species come into existence in their present form? The general fact that they do react, and that they have been evolved from preëxistent types by a process in some degree of the survival of the fittest, is currently believed. The horticulturist to-day produces what he openly calls species in the vegetable kingdom. Are not his methods indicative of the line to pursue in answering the more recondite questions of descent and multiplication?

In conclusion, to come to that in which more nearly I myself am compelled to work, I wish to state that the study of local floras—the study of the flora of one's back yard in a city, of his stone wall, of the roof of his house, if we have an old house, of an old cheese-box—is far from being a mere determination and enumeration of the several species represented. It is becoming a census of the individuals, an

investigation of the communities that they form, and of the interlocking of these into greater, more complex communities; a study of the external configuration of individuals, with reference to their resistance to undue humidity, undue dryness, unusual cold, extreme heat; an anatomical study of their several organs as connected with the same factors; a chemical study of their secretions in the same light; and, finally, a return to that with which I began, a study of their protoplasm in all its phases.

Anatomy: What is the Morphologic Status of the Olfactory Portion of the Brain? PROFESSOR BURT G. WILDER.

IN view of the multitude of problems now confronting anatomists,* it has seemed to me that the present occasion may be best utilized by discussing, in some detail, a single topic which has, nevertheless, intimate relations with several others in anatomy and embryology, human and comparative. Most of the points are indicated upon the wall-maps exhibited.†

Stated more specifically, does *the olfactory portion of the brain constitute a definitive segment; or does it, together with the striatum and pallium, constitute merely the 'dorsal zone' of a segment whose ventral zone is the 'pars optica hypothalami,' i. e., the region about the chiasma?*

As a basis for the consideration of this question are offered the following propositions, the validity of which each must determine for himself:

1. We must distinguish between the *potential neuromeres*, the precise number of which may not be determined for decades, and the *definitive segments*, which are convenient and natural divisions, even if not all of equal morphologic value.

2. For the determination of the segmental constitution of the brain more reliance is to be placed upon comparative anatomy and embryology than upon the structure and development of that morphologic monstrosity, the human brain.

3. The recent enactments of the Anatomische Gesellschaft upon this subject (B. N. A., 1895) are based almost exclusively upon the conditions in a single member of the vertebrate community, man; at the best, even if they apply more or less closely to the other mammals, they constitute an example of 'class-legislation.'

4. When a writer employs a term in a sense other than either (*a*) that which is generally accepted, or (*b*) that in which it was first introduced, or (*c*) that in which it is used by other writers whose views he may be discussing, it is incumbent upon him to state explicitly the sense in which he proposes to use it.

The present obstacles to the recognition of a rhinencephalic segment are three, viz.: (1) The common impression as to the insignificance of the olfactory region. (2) The existence, in the higher vertebrates, of the modification designated by me as the diencephalic flexure. (3) The adverse view adopted in the B. N. A., based largely upon the assumption that the region

*In 1894 I stated (Records of the Association of American Anatomists, sixth meeting, p. 32) that, in addition to about fifty special questions respecting each of the fifty particular cerebral fissures, there are at least one hundred general problems connected with them as a group of features of what is commonly mentioned as a single organ.

†These included diagrams of the brains of man, sparrow, turtle, *Necturus*, *Ceratodus*, *Scymnus* (after T. J. Parker), *Chimæra*, *Polyodon*, *Petromyzon* and *Bdellostoma*: a diagram of the mesal aspect of the human thalamus, *etc.*, exhibiting the location of the aulix ('*sulcus Monroi*') as first described by Reichert, together with the deflection of its cephalic half as proposed by His; and schemas representing (*a*) the dorsal aspect of the six definitive segments now recognized by me; viz.: Rhinencephal, Prosencephal, Diencephal, Mesencephal, Epencephal, Metencephal; (*b*) the same as if medisected; (*c*) the several brain flexures, especially the diencephalic; (*d*) the five different topographic relations to the general axis of the brain (as represented by the olfactory crus) of the presumed psychic expansions.

cephalad of the mesencephal comprises dorsal and ventral zones demarcated by an alleged sulcus connecting the mesocele with the *recessus opticus*.

1. Doubtless all members of this society have discarded the anthropotomic estimate of the olfactory bulbs and their crura as constituting merely a 'first pair of cerebral nerves.' But not all, perhaps, fully realize that, notwithstanding their complete absence in certain adult Cetacea, in most Mammals the olfactory bulbs are quite massive ; that in Batrachians, Reptiles and most Selachians they constitute a large proportion of the brain ; and that in lampreys and hags they equal in size 'the cerebral hemispheres.'

Had the study of the vertebrate brain begun with Myxine or Bdellostoma the olfactory bulbs would have been unhesitatingly assigned a rank at least equal to that of either of the three following subdivisions.

Whatever the ontogeny in a given case, it is probable that phylogetically the smelling portion of the brain preceded the reflective.

"The revolution, so to speak, of the 'hemisphere' about the olfactory axis accords with other considerations which have led Spitzka and the writer independently to consider the prevailing idea that the olfactory lobes are mere appendages of the cerebrum as nearly the reverse of the truth."*

2. The Diencephalic Flexure. With Reptiles, Birds and Mammals, the forms with which most anatomists are more familiar, the first (cephalic or 'anterior') of the series of cavities seems to be the '*ventriculus tertius*'; indeed, in some Birds and Mammals the recess at the root of the optic nerve actually lies farthest cephalad. This condition seems to be associated with the general crowding of the cerebrum dorsad and caudad over the other parts of the brain. It is discussed briefly in the *American Association Proceedings*, 1887, pp. 250–251 ; *American Naturalist*, October, 1, 1887, 914–917 ; Reference Handbook of the Medical Sciences, VIII., 112, and *Journal of Comparative Neurology*, VI., 128.

The following propositions seem to me warranted by the conditions in Batrachians and 'fishes :'

However numerous or sharp the dorso-ventral flexures of a given brain, for comparison with other brains or with an ideal schema the axis is to be regarded as straight.

Whatever its actual position, the aula or mesal space between the two portas ('foramina of Monro') constitutes the cephalic member of a longitudinal series of cavities.

From the standpoint of comparative neurology the terma ('*lamina terminalis*') is a constituent of the floor of the encephalic cavities ; its dorso-ventral position in Reptiles, Birds and Mammals no more converts it into a morphologic end-wall of those cavities than its dorso-caudal inclination in certain forms entitles it to be interpreted as a portion of the roof.

3. In order to be entitled to rank as a definitive segment must a given region exhibit the dorsal and ventral zones of His ?

Conceding, for the present, the constancy and significance of these zones in the myel (spinal cord) and in the brain as far as the cephalic orifice of the mesocele ('aqueduct'), are they represented in the region beyond ?

In the absence of complete developmental and histologic evidence on that point, my provisional answer in the negative is based upon two very different considerations :

First, the general distinctions between the parts derived from the first encephalic vesicle and the rest of the cerebro-spinal axis. *Secondly*, the unsatisfactory presentation of

* The Dipnoan Brain, *American Naturalist*, June, 1887, p. 546.

the subject by those who attach most importance to it.

In 1859 and 1861 Reichert described and figured (Der Bau des menschlichen Gehirns, Plates II., X., XI., p. 65, line 5) a furrow on the mesal aspect of the thalamus, connecting the 'aqueduct' with the *foramen Monroi*. To this he applied the name *sulcus Monroi*, which has been generally employed. In 1884 the mononym *aulix* was proposed by me, and the feature has been shown distinctly in the *New York Medical Journal*, March 21, 1885, p. 327, and 'Reference Handbook,' Vol. VIII., p. 122, and IX., Fig. 418.

In his exposition of the schema adopted by the Anatomische Gesellschaft (B. N. A., pp. 157–159) Professor His insists upon the great morphologic significance of the dorsal and ventral zones, and of the '*sulcus limitans ventriculorum*'* by which they are demarcated. He further declares that the continuation of this sulcus is the *sulcus Monroi*. But his figures represent the sulcus as terminating, not, as with Reichert, at the *foramen Monroi*, but at or near the optic recess, and, without explanation of the radical deflexion, he says, "Die Sulci Monroi laufen jederseits im *Recessus opticus* aus." The confusion caused by this unspecified transfer of a title to a different feature is augmented by the account of the same matter by C. S. Minot in the *Popular Science Monthly*, July, 1893; here the text is explicit as to the importance of the sulcus and its termination at the *foramen Monroi;* but the figure represents the boundary between the zones at a point farther caudad.

In this connection it should be stated that the recent studies of Mrs. S. H. Gage upon embryo cat, turtle, batrachian and bird (*Amer. Nat.*, October, 1896, 837) have revealed sulci having various directions, but not, apparently, demarcating the dorsal and ventral zones.

*For this I have proposed the more definitely correlated name *sulcus interzonalis*.

In view of the present aspect of the case, while I see no impossibility in the representation of the dorsal and ventral zones in the first three segments of the brain, and while such zones might well be demarcated by the furrow originally described by Reichert as '*sulcus Monroi*' (my *aulix*), I hold that the interpretation of the olfactory portion of the brain as merely one part of the dorsal zone of a segment must be supported by something more than the designation of a limiting sulcus which is apparently either non-existent or without interzonal significance.

Psychology. PROFESSOR J. MCKEEN CATTELL, Columbia University.

THE speaker said that the knowledge of paleontology, reasonably presupposed by Professor Osborn on the part of all students of natural science, could scarcely be expected in the case of psychology. Neither was it possible to exhibit the whole of psychology on a single blackboard, as Professor Osborn had done for paleontology, or even in a more bewildering series of charts, such as Professor Wilder had found needful for neurology. He could only make some very general, and, he feared, somewhat trivial remarks.

Each science has problems in common with other sciences and problems peculiarly its own. We who are trying, each of us, to advance some little department of science cannot but sometimes stand at gaze before the magnitude of modern science. How can we see the forest for the trees, the library for the books, the world for the facts? Professor Klein has said that mathematics is ten thousand years in advance of the other sciences, but how does he know whether the sciences are an asymptote to his mathematics or whether mathematics are going off on a tangent to the rest of the universe? Professor Klein tells us that to the regular polygon of 65,537

sides Professor Hermes has devoted ten years of his life. It was once a vital question as to how many angels could dance on the point of a needle. Apart from the earmark of material utility, it is not easy to adjust scientific values. We trust that in religion, in art and in science there is, in addition to the transient, the permanent. But it is a problem, and a difficultone, for the soldier in the thick of battle to reflect on international law and constitutional history.

The magnitude and the multiplicity of science suggest a problem that has always been emphasized in this society. Each of us is a teacher:

"And gladly wolde he lerne and gladly teche."

But what shall he learn and what teach, what forget and what ignore? Admitting the narrow capacity of a single mind, with what shall it be filled? Each with diverse contents, doubtless, if we are to secure the best results. But what shall be the common property of all—what should we learn and teach in school and college? Certainly none here can ignore the doctrines of evolution; probably none should neglect the fundamental concepts of physical science; perhaps we should all know how to use a tool as fine as the calculus. But should a large part of the six or eight years of greatest receptivity be given to Latin and Greek? It is a difficult question. The classics, in our present civilization, are a mark of culture that no one likes to be without. But are they the causes of culture, or only its insignia? Are they to be classed with white linen and polished shoes, possibly even with tight lacing and high heels, or do they give us more life and better?

Turning now to the problems concerning the content of the biological sciences, I venture to maintain that the science of to-day is either quantitative or genetic. Modern physical science is scarcely older than the doctrine of the conservation of energy —50 years old. Modern biological science may properly date from 1859. The physical sciences then became quantitative, and the biological sciences then became genetic. Earlier, the sciences were largely engaged in giving things names. The zoologist, the botanist, the psychologist, and even the physicist had the naïve faith in names as a method of description of the little girl who remarked that Adam had given a very appropriate name to the hog. We still, I fancy, have a somewhat exaggerated confidence in laws, theories and animistic personifications, as explanations of the development of living things. I believe that the great problem now before biological science is to add to its genetic method the quantitative method of physical science, and thus apply a kind of description, economical and far-reaching beyond all others.

Yet, here another problem arises. When we have our quantitative and causal science, our formula bears about the same relation to the world that it is intended to express as a herbarium does to a primeval forest. Our regard for the body of nature becomes that of the anatomist rather than than that of the lover. How can we reduce things to an abstract formula without ignoring their concrete and infinite variety? Fortunately, the subject of this discussion is the biological problems of to-day, not their solution.

As to the problems peculiar to the psychologist, it would be scarcely becoming to bring our family quarrels before the larger public of the biological sciences; besides, they are too numerous to be even mentioned in the latter part of ten minutes. I do not like the term 'the new psychology.' I prefer to maintain that psychology is one of the oldest of the sciences. Still, if modern physics is only 50 years old, and modern biology only 40 years old, modern psychology is still younger. I am not as old as I

expect to be some day, but I was, I think, the first professor of psychology as a separate subject, not only in America, but anywhere. When our present psychology is so young, it is natural that there should be difference of opinion, and even confusion, in regard to its scope and methods.

Our great problem, it seems to me, is the one I have already mentioned as common to all the biological sciences—the extension and coördination of the genetic and quantitative methods. And we have really accomplished a great deal. There was no laboratory of psychology in America, and only one in the world, prior to 1883. Now they are everywhere—perhaps forty in American colleges and universities. In nearly all these laboratories experiments are in progress, which are enlarging our knowledge of sensation, of movement, of feeling and of action. Parallel with this development of experimental psychology, bringing our science into fruitful relations with the physical and mathematical sciences, there has been a noteworthy advance in genetic psychology—witness the address of the President of our Association this year—placing mental development in close touch with all the biological sciences. At the same time increased knowledge of the relations of body and mind has made almost a special science of physiological psychology. Degeneration is a phenomenon common to all the biological sciences, but unfortunately one very prominent in the subject-matter of psychology. Here we have a wide field with many points of contact with pathology and medicine. In the interrelations of minds we cross the paths of anthropology, of sociology, of philology and of history. Psychology is concerned with art and with conduct; it is essential to a sane philosophy.

The subject-matter and the problems of psychology are entangled with those of many sciences, but perhaps with none so closely as with those represented in this discussion. We students of psychology need to know what you are doing, and welcome as a help this affiliation of societies. We hope that you in turn will find that psychology should not be neglected, but that it contributes something to each of the biological sciences and to the advancement of science as a whole.

Physiology. Professor Jacques Loeb, University of Chicago.

If it be true that the fundamental problem of Physics is the constitution of matter, it is equally true that the fundamental problem of Physiology is the constitution of living matter. I think the time has come for Physiology to return to its fundamental problem.

Living matter is a collective term for the qualities common to all living organisms. Comparative Physiology alone enables us to discriminate between the general properties of living matter and the functions of specific organs, such as the blood, the nerves, the sense organs, chlorophyll, etc. Nothing has retarded the progress of Physiology and Pathology more than the neglect of Comparative Physiology. Comparative Physiology shows that secretion is a general function of all living organisms and occurs even where there is no circulation. Hence it was *a priori* false and a waste of time to attempt to explain secretion from the experiments on blood pressure. Oxidation occurs regardless of circulation, and it was *a priori* a waste of time to consider the blood as the seat of oxidation. Comparative Physiology has shown that the reactions of animals to light are identical with the heliotropic phenomena in plants. Hence it is a mistake to ascribe such reactions as the flying of the moth into the flame to specific functions of the brain and the eyes. Sleep is a phenomenon which occurs in insects and plants, and it would

be a waste of time to attempt an explanation of sleep on the basis of phenomena of circulation. The best interests of Physiology and Pathology demand that the systematic development of Comparative Physiology be one of the physiological problems of to-day.

May I be pardoned for calling attention to one special field of Comparative Physiology which I believe to be especially fertile? I refer to the field of Physiological Morphology. I applied this name to the investigation of the connection between the chemical changes and the process of organization in living matter. Two series of facts allow us to connect these two groups of phenomena: (1) The fact that phenomena of fermentation lead to an increase in the number of molecules, and thus bring about an increase of osmotic pressure in the cells. This increase of osmotic pressure is the source of energy for the work of growth. (2) The facts of heteromorphosis, *i. e.*, the possibility of transforming in certain animals one organ into another or substituting one organ for another, through external influences, such as gravitation, contact, light, etc.

The exact and definite determination of life phenomena which are common to plants and animals is only one side of the physiological problem of to-day. The other side is the construction of a mental picture of the constitution of living matter from these general qualities. In this portion of our work we need the aid of physical chemistry and especially of three of its theories: Stereochemistry, van 't Hoff's theory of osmotic pressure and the theory of the dissociation of electrolytes. We know that the peculiar phenomena of oxidation in living matter are determined by fermentative processes, and we venture to say that fermentations form the basis of all life phenomena. It has been demonstrated that fermentability is a function of the geometrical configuration of the molecule. Saccharomyces cerevisiæ is a ferment for such sugars only as have three, or a multiple of three, atoms of carbon in the molecule. Among the Hexaldoses only d-glucose, d-mannose and d-galactose are fermentable, while their stereoisomeres are not fermentable. But the influence of the geometrical configuration goes farther. Voit has suggested, and Cremer has demonstrated, that there is a far-reaching parallelism between the fermentability and assimilation of Carbohydrates. Higher animals as well as yeast cells are able to form glycogen from such carbohydrates as are fermentable by yeast. The further development of these stereochemical relations and their extension to proteids and nucleins is another of the problems of Physiology which will contribute to the main problem, the analysis of the constitution of living matter. I believe that the influence of stereochemistry will be more or less directly felt in many branches of Physiology, in questions of heredity as well as in the theory of space sensations, as E. Mach has already intimated.

Van 't Hoff's theory of osmotic pressure permits an application of the law of conservation of energy to a class of phenomena to which this law was hitherto inapplicable, namely, the phenomena of growth, functional adaptation, secretion, absorption and even pathological processes, such as œdema. The physiologists who thought that the blood pressure determined secretion could not understand why secretion took place under a higher pressure than the blood pressure. Comparative Physiology shows that secretion does not depend upon circulation, and the theory of osmotic pressure indicates that the osmotic pressure in the cells is more than twenty times as high as the blood pressure. The work of secretion is done by osmotic pressure, and not by blood pressure. A

prominent physiological chemist has become a vitalist because he could not explain why the secretions differ from the blood from which he thinks they are formed. He overlooks, among others, the fact that the protoplasm possesses the quality of semipermeability, which means that it allows certain substances to pass through, and others not. In my opinion, the working-out of a theory of semipermeability is one of the main physiological problems of the day.

The theory of the dissociation of Electrolytes is of fundamental importance in the analysis of the constitution of living matter. Pharmacology will feel its influence most directly. Everything seems to indicate that the specific physiological effects of inorganic acids are due to the number of positively charged Hydrogen Ions in the unit of solution, and the specific physiological effects of alkalies to negatively charged Hydroxyl Ions. But the universal bearing of the theory of dissociation upon Physiology will perhaps be best seen in the field of animal electricity. An active element of living matter is negatively electric to its surrounding parts. We may assume that an acid is formed in the active part, and that the passive parts are neutral. The positive Hydrogen Ions of the acid have a much greater velocity of migration than the Anions. Hence the former will diffuse more rapidly into the passive tissue than the Anions, and the active tissue will remain negatively charged.

At no time since the period immediately following the discovery of the law of conservation of energy has the outlook for the progress of Physiology appeared brighter than at present. But in order to reap the full benefit of our opportunities we must bear in mind that the fundamental problem of Physiology is the determination of the constitution of living matter, and that in order to accomplish our task we must make adequate use of Comparative Physiology as well as Physical Chemistry. Pathology, in particular, will be benefited by such a departure.

Developmental Mechanics. PROFESSOR T. H. MORGAN, Bryn Mawr College.

IN the last few years a new movement has started in embryology known as Entwicklungsmechanik, developmental mechanics, or rather the mechanics of development. In the few minutes at my disposal I shall try to show:

I. How the term Entwicklungsmechanik arose and how it has been defined.

II. I shall try to give an idea of the kind of work that has been done.

Roux, in 1885, first used the word developmental mechanics and defined it as the study of the causal morphology of the organism. It is of importance to note that Roux uses the word mechanics not only in its physical sense, but in its wider philosophical meaning. Therefore, in the definition of developmental mechanics as the study of the causal morphology of the organism, Roux means simply that the changes in form through which the embryo passes are the result of a series of causes, and these causes are what the new study proposes to investigate.

It may seem pretentious to state that this is a new study, for every embryologist must believe that the ultimate goal of his work is to determine, as far as possible, the causes of development. But let us look a little more closely into Roux's position.

Perhaps the problem may appear clearer if we consider it in the form of a concrete example. In what way, for instance, would the study of the mechanics of development differ from ordinary descriptive embryology?

We see the egg segment and then form a blastula, gastrula and larva. Descriptive embryology gives a series of pictures of these

different stages. The more complete the series the fuller will be our knowledge.

Now Hertwig maintains that this knowledge of the successive stages of development is itself causal knowledge beyond which we can not hope to go. He holds that the egg is the *cause* of the blastula and the blastula the cause of the gastrula, etc. Hertwig pretends to be completely satisfied with knowledge of this sort.

Comparison is not perhaps always just, yet Hertwig's position is the same, I think, as though a physicist were to say that if we knew the path of the moon around the earth we should know everything that we could hope to know, or if the astronomer claimed that the position of the moon at one moment is the *cause* of its next position.

Roux, on the other hand, maintains that in order to understand the successive stages of development we must know how the one transforms itself into the other, how the blastula invaginates to form the gastrula, how the medullary plate of the vertebrate embryo rolls in to form a tube. The movements, then, of the parts of the embryo are to be studied. But even a knowledge of the movements of cells and groups of cells would not be causal knowledge, although it might, perhaps, be called the mechanics of the embryo. What makes the endoderm turn in? What induces the medullary plate to roll up into a tube? What, in brief, are the forces at work?

A few illustrations of the kind of work that embryology has already accomplished may bring before us more clearly the problems of to-day.

Pflüger's experiments on the effect of gravity on the segmentation of the egg naturally suggest themselves first. When the egg of the frog is inverted, with its dark hemisphere turned down, the cleavage planes appear, not in their normal position, but in respect to the direction of the force of gravity. At first Pflüger seemed to think that there is some causal relation between the force of gravity and the forces that direct the cleavage of the egg.

Roux showed, however, that a centrifugal force could replace the force of gravity, and, moreover, that if the experiment were so arranged that the centrifugal force *just* overcame the force of gravity then the egg segmented normally in whatever position it was placed.

Finally Born showed that a rotation of the contents of the inverted egg occurred so that the lighter parts rose to the highest points. It is obvious, therefore, that gravity only indirectly affects the egg by bringing about a rearrangement of its contents.

This series of experiments is instructive, I think, in that it illustrates how one experiment leads to another, and how our knowledge of the forces at work is advanced with each well-planned experiment. We do not know, to be sure, why the egg segments, but we have found out something definite about the action of gravity on the egg.

Let us now consider another series of experiments: Roux found that by preventing the development of one of the first two blastomeres of the frog's egg the other uninjured blastomere developed into a half-embryo. Naturally enough, he drew the conclusions that the first two cells are self-differentiating, and that the development is, at least in part, a mosaic work. The conclusion was, I believe, not justifiable at the time, because in the experiment the injured half of the egg remained in contact with the developing half.

Later experiments on other forms—the Sea-urchin's egg, for example, where the blastomeres can be completely separated—gave other results. A whole embryo developed from the isolated parts. Roux's conclusions were said to be overthrown. Then came an unexpected result. The blastomeres of the ctenophor may be com-

pletely separated, as perfectly as those of the echinoderm, but in the ctenophor the isolated blastomere develops into a half-embryo. Evidently, then, any new theory of development must explain how in one case it is possible for an isolated blastomere to develop into a half-embryo, and how in another case into a whole embryo. Perhaps the explanation is not far to seek, for it has been found that in one and the same egg the blastomere may under certain conditions give rise to a half-embryo, and under other conditions to a whole embryo of half size.

I might, had I time, cite many other experiments: those, for instance, in which a part of the unsegmented egg has been removed; Boveri's experiment in which a non-nucleated piece of an egg is entered by a single spermatozoön and an embryo forms; the experiments and observations of the direction of the nuclear spindle in the dividing cell; the experiments on the effects of different salts on development; the effects of light, heat and electricity on the egg or embryo, etc.

These experimental studies will serve as examples of the kind of work of the new embryology.

The two instances that I have already given—the effect of gravity of the egg, and the behavior of isolated blastomeres—teach us that the greatest precaution must be used before we can know whether a suggested mechanical explanation is really a true explanation. There is, I think, but one way in which we may hope to find out what forces or energies are at work during development, and whether these forces are the same forces known to the chemist and physicist. Only by means of well-planned experiments can we expect by isolation and recombination to discover the forces at work. Here, it seems to me, we find at least the real meaning and strength of developmental mechanics.

I admit freely that developmental mechanics is not a fortunate expression, but, nevertheless, Roux and his school have from the start encouraged experimental methods.

Perhaps it would be more appropriate to call the new work 'experimental physiology' of the embryo, using physiology in a wider sense than that usually given to it. For myself, I think our aim is reached if we use the term experimental embryology.

The history of science teaches us that by means of experiment chemistry and physics have made enormous progress; by means of experiment animal and plant physiology have become more exact, more profound studies than animal and plant morphology, and the department of bacteriology shows how rapidly and surely a study may advance by this method. Therefore, by means of experiment the student of the new embryology hopes to place the study of embryology on a more scientific basis.

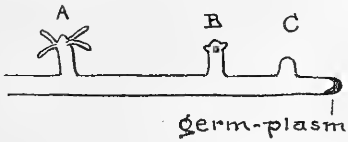
Morphogenesis. Dr. Chas. B. Davenport, Harvard University.

Morphogenesis may be defined as the study which attempts to explain the development of the form of the individual (ontogenesis) and of the race (phylogenesis).

Morphogenesis is a subdivision of general physiology, inasmuch as it deals with activities—processes, and, indeed, the largest, most complex biological processes, those by which the course of individual development is controlled and the direction of evolution is determined. Morphogenesis includes developmental mechanics in so far as that study attempts to explain the ontogenetic processes.

The scope of morphogenesis, embracing, as it does both ontogenetic and phylogenetic processes, is a broad one. Too broad, some may say who believe that there is no close relation between phylogeny and ontogeny; that ontogeny goes its way and phylogeny

goes its way and neither takes account of the other. Others do not share this view. They look upon the soma and the germ as very intimately bound together—associated in much the same way as the stolon and the hydranths of a hydroid are.



The germ plasm at the tip of the stolon gives rise at intervals to hydranths very much as the germ plasm of other animals gave rise at intervals to somas. In both cases the germ plasm is modifiable to a limited extent by such modifications of the soma as result from starvation, reduction in general vigor, or the secretion of specific substances affecting the germ plasm. In both cases developing soma and germ may be simultaneously modified by external agents, so that while the developing generation C is being changed, future generations, D, E, etc., are being potentially changed in the same fashion because in the germ plasm. For example, although I do not know that the experiment has been tried, a dense solution might produce a spindling soma C and a spindling stolon, so that even if the solution were diluted again a spindling soma D would rise. By other agencies we may modify the protoplasm at the tip of the stolon so that it will thenceforth tend to produce modified hydranths. Just as the formation of the stolon and hydranth are parts of one developmental process, so are phylogenesis and ontogenesis parts of one process. Every ontogenesis is dependent upon a preceding phylogenesis and every phylogenesis is dependent upon a preceding ontogenesis.

I have said that morphogenesis seeks to explain the development of the individual and the race. When have we explained development? We have explained any effect when we know its immediate causes—that is to say, the essential conditions under which the effect occurs. We seek, then, to know the essential conditions under which phylogenesis and ontogenesis occur.

What general methods must we employ to learn these conditions of development? There are two principal methods: one is the method of observation of the differences in development under known dissimilar conditions; the second method, more applicable and more certain, is the method of experiment.

I may illustrate the way in which simple comparative observation and observation with experiment throw light upon the processes of development. The simple observation that in the tunicate Doliolum the sexual buds, detaching themselves from the ventral stolon, crawl over the surface of the animal to the dorsal stolon to arrange themselves there in regular order might have taught us that one of the conditions directing individual development is response of the different parts of the developing individual to stimuli coming from other parts of the organism. On the other hand, the experiments of Driesch upon the gastrula of sea-urchins enforced the fact vividly, for he found that even after the mesenchyme cells had been hopelessly mixed up by shaking the gastrula they still migrated toward their destined place. So, too, the observation of the decline of the descendants of famous men might have led us to the law of regression toward mediocrity as a condition of phylogenesis just as Galton's experiments with sweet peas did. In the foregoing cases there is, however, a precision and decisiveness about the experimental method which marks it as one to be preferred where applicable. In addition to experiment, an allied method applicable especially to the study of variation is that

of statistics. As by experiment we make all causes similar except one and note the result, so in statistics we select results having at least one common cause and throw all together, believing that, from the doctrine of chances, all other causes will offset and annul each other. Thus we find, by comparing the mean in the selected group with the mean of the whole population, the effect of the particular cause used as a basis of selection.

So much for definitions and general methods. But I have been asked to suggest particular problems in morphogenesis and the methods of their solution. Of ontogenetic problems we have the question in how far is the development of the individual to be explained as a series of responses to the action of stimuli; not merely of stimuli external to the organism, but of part acting on part 'as in the marvelous automaton' —to use Aristotle's phrase. We get indirect evidence upon this matter in studying the capacity and laws of response in unicellular organisms; we get direct evidence by applying particular agents, such as light, heat and chemical substances, and noting their effect on development. Again, we have the question in how far the development of the individual is determined by wholly internal factors. To get an answer to this question one must mutilate the form and study the laws and limits of its restoration—regeneration, reparation, healing, development despite untoward conditions (as in dermoid cysts), and self-regulation (or accommodation) in disturbed ontogeny. In how far is the regeneration of organism comparable with that of crystals?

Next we come to a number of problems connected with both ontogeny and phylogeny. Such are the problems of adaptation. There is adaptiveness in those responses to stimuli that are met with in development—in tactisms, trophisms and differentiation. There is adaptiveness also in regeneration and self-regulation of the organism. These ontogenetic adaptations are often curiously dependent on the past history and habits of the species. Thus, Amœba dwells in dim light and is negatively phototactic, ems of plants which live in the dark turn from the sun, parts of an animal most apt to be lost are frequently those most capable of regeneration. Is it due to selection or is it an inherent quality of all protoplasms that they should respond thus advantageously? Or is this whole phenomenon of adaptation merely an ignis fatuus—this apparent shaping of means to ends only a necessary, mechanical relation? These questions can be answered by paying attention to cases of unadaptive response and unadaptive regeneration and regulation.

Finally, the strictly phylogenetic problems deserve far more attention than has yet been given them. Such are the questions concerning individual variation. It is well known that in some cases the measurements of an organ in the different individuals of a species group themselves about a mean value in accordance with the normal probability-of-error curve. In the case of species undergoing change, however, the curve is often very unsymmetrical or perhaps has several maxima. What is the precise meaning, in any case, of these abnormal curves? Again, how does the mode (or the most common measurement) vary with the habitat or geographical position of the varieties of the species? What is the significance of those large variations which we call sports and how do they differ in origin from individual variations? What sorts of variations in the body are correlated? What is the morphogenetic kinship of the various organs of the body? Then there are the questions dealing with inheritance: The laws of normal inheritance—Do the progeny of a particular cross inherit, on the average, equally from the

two parents in all cases—or is there such a thing as sexual or racial prepotency? Do sports show a prepotency in breeding? What are the limits of inheritance—to what extent and to what degree are modifications of the soma transmissible? What are the laws and limits of crossing—the capacity of hybridization; the abnormal distribution—the patchwork intermingling—of parental characters in the body of the adult hybrid? Next there are the questions, allied to those of crossing, respecting the reciprocal effect between scion and stock in grafting. In how far is there such an effect and what is its cause? How about the phenomena of telegony in animals and of xeny in plants? Finally, there are the momentous questions concerning the relative importance of selection, of sporting with segregation of the aberrant individuals, of crossing and hybridization, and of self-adaptation in the origin of species.

Now, these problems are comparatively untouched. Yet they are recognized as immensely important. The reason why they have not been worked upon is largely because they don't lend themselves to investigation in the laboratory. For the successful study of these problems one needs, indeed, not an ordinary laboratory, but a farm or an extensive zoological reserve with hothouses, breeding ponds, insectaries and vivaria of various sorts. With such means at his disposal a naturalist might hope, during a long series of years, to answer many of these fundamental phylogenetic questions.

CURRENT PROBLEMS IN PLANT MORPHOLOGY.

RELATIONSHIP BETWEEN PTERIDOPHYTES AND GYMNOSPERMS.

THE year 1897 will always remain a memorable one in the annals of plant morphology on account of the illuminating discoveries made by Ikeno* and Hirase† of spermatozoids in Cycas and Gingko, by Webber‡ of spermatozoids in Zamia, by Belajeff § || and Webber ¶ Sm ** of important new facts in spermatogenesis, and by Bower†† of new evidence bearing upon the homologies of spore-producing members.

These investigations, with others somewhat less notable, have already resulted in some important modifications of taxonomic sequence. Engler‡‡ divides the subdivision Gymnospermæ into two series—(*a*) those with functional spermatozoids, including here the Cycadaceæ, Gingkoaceæ and fossil Bennettitaceæ and Cordaitaceæ, each order having also the rank of a class, and (*b*) those with reduced spermatozoids (*Spermakerne*), including the classes Coniferæ and Gnetales. Thus the aberrant genus Gingko has been removed from the order Taxaceæ of the Coniferæ and made the type of a new order, which constitutes a

* Ikeno, S. Vorlaüfige Mittheilungen über die Spermatozoiden bei Cycas revoluta. *Bot. Centralb.* 69:1–3. Ja. 1897.

† Hirase, S. Untersuchungen über das Verhalten des Pollens von Gingko biloba. *Bot. Centralb.* 69:33–35. Ja. 1897.

‡ Webber, H. J. Peculiar Structures occurring in the Pollen tube of Zamia. *Bot. Gaz.* 23: 458. *note.* Je. 1897.

§ Belajeff, W. Ueber den Nebenkern in Spermatogenen Zellen und die Spermatogenese bei den Farnkraüten. *Ber. Deutsch. Bot. Gesellsch.* 15: 337–339. 27 Jl. 1897.

|| Belajeff, W. Ueber die Spermatogenese bei den Schachtelhalmen. *Ber. Deutsch. Bot. Gesellsch.* 15:339–342. 27 Jl. 1897.

¶ Webber, H. J. The Development of the Antherozoids of Zamia. *Bot. Gaz.* 24:16–22. 31 Jl. 1897.

** Webber, H. J. Notes on the Fecundation of Zamia and the Pollen tube apparatus of Gingko. *Bot. Gaz.* 24:225–235. 30. O. 1897. (See also *Webber* ‡.)

†† Bower, F. O. Studies in the Morphology of Spore-producing members. The Marattiaceæ. Lond. 1897.

‡‡ Engler, A. Nachtrag zu Teil II.–IV. Pflanzenham. 341. 1897.

class by itself coördinate with the Coniferæ as a whole. Again, Engler's great division of Embryophyta Siphonogama is seen to be unfortunately named, precisely as was pointed out by the writer* as long ago as 1892, for apparently Salvinia has the same right to be described as siphonogamous that Zamia has, and the real difference between seed plants and archegoniates lower than the Cycads appears to be one that lies rather within the sphere of ecology than in that of morphology; the seed coming into existence, perhaps, in more than one phylum through symbiotic relationships established between sporophytic and gametophytic plants of a species. In brief, the group of Spermatophyta, while ecologically, is not morphologically, homogeneous.

Van Tieghem,† whose interesting innovations in the taxonomic arrangement of higher plants seem to have attracted less attention than their various merits deserve, founds a new type of what he terms basigamous fecundation (*basigamie*), upon the investigations by Webber of Zamia. A useful criticism of Van Tieghem's general notions regarding flowering plant taxonomy, as set forth in various papers since 1894, ‡ § ‖ will be found in the work of Engler previously cited. It is interesting to note how the new light has been welcomed in both these taxonomic systems—Engler's, representing, upon the whole, the most modern development of conservative and slowly developed ideas, especially those of Eichler, and Van Tieghem's, representing, in a radical and novel manner, the influence of recent cytologic work on the embryo-sac and upon ovular development.

The importance of these discoveries upon spermatogenesis in particular have, however, much more than a formally taxonomic interest, for they open up in an inspiring way a number of cytological and morphological problems. They cast new light upon the vexed question of the sequences among Pteridophytes and make more certain the general acceptance of Bower's doctrines regarding the basal position of the Lycopodiaceæ rather than of the older view of Prantl, reaffirmed by Goebel, that Hymenophyllum-like ancestors connected the fernworts with the mossworts, or the view of Campbell, who sought in Ophioglossum the primitive type. For in the spermatogenesis of Zamia may be seen a recapitulation of spermatozoid improvement, and one learns how the biciliate form found in club mosses might, by the gradually increasing elongation of Webber's *blepharoplast*, or cilium-producing organ, be converted into the multiciliate form found in eusporangiate ferns and continued among higher ferns, in Cycads and in the Gingkoaceæ. Indubitably, then, the new investigations strengthen greatly the position that the biciliate-spermatozoid forming Lycopodinæ are, as a class, lower than the Filicinæ with their multiciliate spermatozoids. Precisely the same result has been reached by investigations on the sporophytic side, notably by Bower in the paper cited and in others.*†

Regarding the phylogeny of Pteridophytes

*MacMillan, C. Metaspermæ of the Minn. Vall. 25. 1892.

†Van Tieghem, Ph. Sur une nouvelle sorte de Basigamie. *Journ. de Bot.* 11: 323-326. 16 Oct. 1897.

‡Van Tieghem, Ph. Acrogamie et Basigamie. *Jour. de Bot.* 9:465–469. 16 D. 1895.

§Van Tieghem, Ph. Sur les Phanérogames sans grains, etc. *Comptes Rend.* 124: 590-595. 22 Mr. 1897.

‖Van Tieghem, Ph. Classification nouvelle des Phanérogames. *Comptes Rend.* 124: 919-926. 3 My. 1897.

*Bower, F. O. Studies in the Morphology of Spore-producing Members. Equisetineæ and Lycopodineæ. Phil. Trans. Roy. Soc. Lond. 185 B. 473–572. 1894.

†Bower, F. O. Studies in the Morphology of Spore-producing Members. II. Ophioglossaceæ. London. 1896.

the following points may be regarded as settled:

1. *Phylloglossum drummondii* is the simplest known living Pteridophyte.

2. The fertile spike of Ophioglossum is derived by sterilization in transverse planes of a bilocular Tmesipteris-like sporangium.

3. *Tmesipteris tannensis* is, of known forms, the club moss nearest to the Filicinæ.

4. The sporangia-bearing leaves of Marattiaceæ and Leptosporangiate ferns homologize with the fertile spikes alone of Ophioglossum leaves.

5. In the sense in which sporophylls occur in Lycopodinæ they also occur in ferns among the Ophioglossaceæ, but in Marattiaceæ only the stipules remain to represent the old sporophyll lamina of archetypal ferns. In Leptosporangiate ferns even the stipular vestige has disappeared.

6. The Isœtaceæ, Salviniaceæ and Marsileaceæ are terminal groups.

7. Either seed-producing plants are of polyphyletic origin or the multiciliate type of spermatozoid has been developed in more than one branch of archegoniate plants.

Concerning the latter point it is proper to observe that most students of phylogeny have looked for the archetype of the Coniferæ in the vicinity of Selaginella. It will be noted that all genera of seed-producing plants known to produce spermatozoids do not produce biciliate, but multiciliate, spermatozoids. The embryogeny, however, of Lycopodinæ, notably of Selaginella, is much more similar to that of seed-producing plants than is the embryogeny of such ferns as Isœtes. With Isoetes and the Marattiaceæ the Cycads, however, show some striking points of similarity, and it may be that this group of seed-plants is allied rather with Filicinæ than with Lycopodinæ. If it be accepted that the prevalent pinnation of fern leaves is really of very profound significance and indicates the presence among their ancestral types of a Tmesipteris-like form with bilocular bilateral sporangium, capable of development into the fertile spike of Ophioglossum, it may also be held as probable that the pinnation of carpellary leaves of Cycas has a similar profound significance. On the other hand, the strobiloid features of the Zamiæ may also be fundamental and a Selaginella-like ancestor may, therefore, be proposed. In this case the multiciliate sperm of Gymnospermæ would be held to have an independent origin as compared with the multiciliate sperm of Filicinæ and Equisetinæ.

Of Equisetum, indeed, the archetype among living club-mosses would seem to be most closely reproduced in Psilotum with its radially trilocular synangia, and the difference between radia and bilateral synangia may be as important as indicated by Celakowski.* According to this student of phylogeny the radial type of synangium is the most ancient and is perpetuated in Gymnosperms as well as in Equisetinæ. There are, however, three types of synangia derived by sterilization of simple Lycopodium-like sporangia. These are as follows:

1. The radial type. Exemplified in Psilotum, Equisetum, Taxus.

2. The bilateral type. Exemplified in Tmesipteris and leading to the fertile spike of Ophioglossum and to the 'sporangiophyll' of Marattiaceæ and Leptosporangiate ferns and possibly to the carpels and stamens of Cycas.

3. The reticular type. Exemplified in Isoetes.

In Cycadaceæ the sporangial type is, from the pinnation of carpels, originally not trabecular, but bilateral, indicating either a Tmesipteris-like ancestor or an independent bilateral modification of the Selaginella

* Celakowski, L. J. Nachtrag zu meiner Schrift über die Gymnospermen. Engl. *Bot. Jhrb.* 24:202–231. 17 Ag. 1897.

type of unilocular sporangium. It is therefore impracticable to connect Cycas with Isoetes, on account of the sporangial structure, and either an independent development of heterospory must be assumed for the Cycadaceæ or they must be connected with the Coniferæ and traced back to Selaginella. That is, the evidence on the whole points to an independent deve opment in Cycadaceæ, and also probably in Gingkoaceæ, of multiciliate spermatozoids. This conclusion is borne out by the marked peculiarities of Cycad and Gingko spermatozoids as described by Ikeno, Hirase and Webber, although important resemblances between the development of the spermatozoid in Zamia, as described by Webber, and in Equisetum, as described by Belajeff, must be conceded.

The researches most needed at present are upon the genesis of the sperm-nucleus in Coniferæ and Gnetales to discover whether bodies which might be regarded as reduced blepharoplasts are present, and if so whether they indicate a multiciliate or biciliate spermatozoid in primitive Taxaceæ.

In general, it may be said that the polyphyletic theory of the origin of the gymnosperms is strengthened by the new researches, but it remains more difficult than before to include Isoetes-like forms among the probable ancestors of seed-plants. In addition, the very considerable differences between gymnospermous and angiospermous seeds arising from the wide variance in endosperm formation, together with the singular inversion (?) of the female plant in VanTieghem's Basigameæ and the suppression of the ovule in his Inovuleæ and of the nucellus in the Innucelleæ, together justify the view that the Spermatophyta is not a homogeneous group, but is purely ecological, comprising groups of widely different phylogeny, but, in general, similar adaptations arising under what I have previously termed symbiotic alternation of generations.

Conway MacMillan.

PALEONTOLOGICAL NOTES.

Among the recent papers of Mr. A. Smith Woodward, of the British Museum, are several matters of general interest in paleontology. Referring to Professor Marsh's discussion at Ipswich of the 'Jurassic Age of the Wealden Vertebrate Fauna,' Mr. Woodward has listed the Wealden fishes very carefully, and concludes as follows:*

"The result is, therefore, that all the known English Wealden fishes are survivors of typically Jurassic genera, except *Neorhombolepis* and *Cœlodus*, and these are their little-modified representatives. None but *Belonostomus* appear to range throughout the Cretaceous. In fact, the Wealden estuary seems to have been the last refuge of the Jurassic marine fish fauna in this part of the world, not invaded even by stragglers from the dominant race of higher fishes which characterized all the seas of the Cretaceous period. The Wealden river drained a land where a typically Jurassic flora flourished; the only two known Mammalian teeth from the Wealden resemble those of a Purbeckian genus, and now it is clear that the fishes agree both with these and the reptiles in their alliance with the life of the Jurassic era."

The second note relates to the occurrence of a gigantic Pterodactyl in the Cretaceous of Bahia, Brazil, and concludes with the following note:†

"Not being able to determine the genus of the Brazilian Cretaceous Pterodactyl, it is equally impossible to estimate the size of the skull or the animal itself from a single bone. There is too much variation from the proportions of the snout and the relative dimensions of the head among Pterodactyls to admit of any such induction. To judge by Marsh's figure of the skull of *Pteranodon*, however, the Brazilian form must have even exceeded in size the gigantic species of this North American genus, of which the head sometimes attains a length of four feet."

* 'On the Affinities of the English Wealden Fish-Fauna.' *Geol. Mag.*, Vol. III., No. 380, p. 69.

† 'On the Quadrate Bone of a Gigantic Pterodactyl,' etc. *Annals and Magazine of Natural History*, Ser. 6, Vol. XVII., 1896.

In a third paper appears the translation of Ameghino's recent summary of his researches upon the geology and paleontology of Argentina,* followed by a critical review of the same by the writer, who has recently examined the Argentine collections. He does not accept the evidence of the very great age assigned to the 'Pyrotherium' and overlying Beds and urges "that Señor Ameghino should show quite clearly why Pyrotherium cannot be a close ally of the large Australian Diprotodonts. It certainly differs from the Proboscidia in some of the most fundamental characters." In the Red Sandstones with Dinosaurian remains Dr. Santiago Roth has recently brought back a fine collection of small reptilia.† One of these is a typical and apparently fully-evolved snake, which the author had no time to study in detail. The others are small crocodilia, particularly interesting because they are typical Mesosuchia with the characteristic palate and amphicœlous vertebral centra. They seem to be most closely related to the small Purbeckian *Theriosuchus* and its allies, differing, among other features, in their more highly specialized dentition, and referable to a new genus, which the author names *Notosuchus*.

Another important note‡ relates to a new specimen of *Sterosternum tumidum* from the State of San Paulo, Brazil, interesting as showing for the first time the general proportions of the trunk and tail of this strange extinct reptile. Stereosternum was originally described by Professor Cope in 1886, and in the same year Dr. Baur made it a type of the new Reptilian order termed Proganosauria. It is now evident, according to Woodward, that the animal is related in some undetermined way to the ancestry of the Plesiosauria. The head is of an elongate triangular form, but much shorter than the neck. The tail possesses not less than sixty vertebræ, of which the foremost seven bear robust transverse processes. As a whole the tail is thus somewhat more than twice as long as the trunk, occupying slightly less than three-fifths of the length of the entire animal. Dr. Derby has also obtained a typical Labyrinthodont tooth from the Silicious Limestones at Conchas. "In fact," Mr. Woodward concludes, "evidence is gradually accumulating to render it still more certain that the Karoo Series of South Africa is well represented by homotaxial deposits in the south of Brazil and in parts of the Argentine Republic."

A new specimen of Ceraterpeton* from the Coal Measures of Castlecomer, Kilkenny, Ireland, is the second example from the typical locality of Huxley's original description thirty years ago. This specimen found by Mr. Robertson is of special importance in making known for the first time many characters of the scapular arch and limbs. It now appears that the amended definition based by Fritsch upon specimens from the lower Permian of Bohemia does not apply to the genus with which Huxley was dealing when he originally proposed the name. The generic name *Scincosaurus* originally applied by Fritsch to his Bohemian specimens ought thus to stand. The skull from the Coal Measures of Ohio described by Cope under the name *C. lennicorne* seems, however, to be correctly placed here; but of this animal the trunk still remains unknown.

H. F. O.

* 'Geology and Paleontology of Argentina.' *Geological Magazine*, Vol. IV., No. 391, p. 4, 1897.

† Ceraterpeton Galvani, Huxley. *Geological Magazine*, July, 1897.

‡ Stereosternum from Brazil. *Geological Magazine*, March and April, 1897.

*Ceraterpeton Galvani, Huxley. *Geological Magazine*, July, 1897.

CURRENT NOTES ON ANTHROPOLOGY.

DEFORMED SKULLS FROM GUATEMALA.

AT a recent meeting of the Berlin Anthropological Society Professor Virchow ex-

hibited and described several skulls from ancient graves in the Kekchi district of Guatemala, brought by Mr. Dieseldorf. They were deformed to an unusual degree, to an extent, indeed, not equalled elsewhere in America. The method of deformation was like that of the Natchez Indians, the forehead flattened and pushed back and upward. Just this deformity is seen on many of the Mayan art works, and instead of being caricatures such are regarded by Professor Virchow as actual imitations of this custom of malformation.

They were very fragile, indicating a high antiquity, and the objects associated in the tombs whence they were derived showed them to be pre-Columbian in age. It will be remembered that from these tumuli Mr. Dieseldorf obtained some of the most artistic pottery products known in America.

NATIVE AMERICAN STRINGED INSTRUMENTS.

This subject is again discussed in a brief article by Professor Otis T. Mason in the *American Anthropologist* for November last. His conclusion is as follows: "After looking over the musical collection of the United States National Museum and such literature as has been collected by the Bureau of American Ethnology I have come to the conclusion that stringed musical instruments were not known to any of the aborigines of the western hemisphere before Columbus."

While the opinion of one so competent as Professor Mason on this subject demands the utmost respect, some of the examples which I quoted in the *American Antiquarian* (January, 1897) are not considered by him, and seem to present a moderate amount of evidence that the musical string was not wholly unknown to the American race by independent discovery.

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

In a recent *Comptes Rendus* Moissan calls attention to the fact that calcium carbid is a powerful reducing agent, and hence, when in a fused condition at a high temperature, can furnish, by double decomposition, a number of new compounds. When acting on metallic oxids the metal may be obtained in a free state, or if it is capable of uniting with carbon a carbid is formed. By this reaction Moissan has prepared crystallized carbids of aluminum, manganese, chromium, molybdenum, silicon, etc.

According to the *Journal de Pharmacie et de Chimie*, Dutremblay and Lugan expect to make a commercial success of the manufacture of oxygen by the manganate method. The process consists of decomposing manganates of the alkalies by steam at 500°, and then regenerating the manganates by heating in a current of dry air. This process was used by Tessié du Motay some thirty years ago, but afterward abandoned, owing to the caking of the charge and evaporation of the soda, there being great danger of explosions. It is hoped these dangers have been now overcome, and that the process will be a success.

A careful study of the valence of glucinum by Arthur Rosenheim and Paul Woge appears in the *Zeitschrift für Anorganische Chemie.* A considerable number of double oxalates and tartrates of glucinum and alkalies was prepared, and in all glucinum shows analogy with the bivalent and never with the trivalent metals. The same is true in its molybdate and in the double glucinum alkali sulfites. A more exact proof of its bivalence was shown by the determination of the molecular weight of the chlorid by the boiling-point method, pyridin being used as a solvent. The molecular weight corresponded to the formula $GlCl_2$. The conclusion of the authors is that glucinum is bivalent, and is

rightly placed in the second group of the periodic table, thus confirming the generally accepted views of chemists.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

INTERNATIONAL CONGRESS OF ZOOLOGY.

AT the meeting of the International Congress of Zoology at Leyden, in 1895, it was agreed that the Fourth Congress should be held in Great Britain, and that the President should be Sir William Flower, K.C.B., F.R.S. As we have already announced, the Permanent Committee of the Congress accepted an invitation to assemble at Cambridge in August, 1898. Sir W. Flower was compelled to resign on account of ill health and Sir John Lubbock was unanimously selected in his place.

The seat of an ancient University, which counts among its alumni distinguished zoologists from the days of Ray and Willughby to those of Charles Darwin and Francis Balfour, seems to offer a peculiarly fit meeting-place for the Congress on its first visit to the British Islands, and the Reception Committee, including the present representatives of zoological science in Cambridge, offer a cordial welcome to their brethren at home and abroad.

The officers of the Congress are: *President*, Right Hon. Sir John Lubbock, D.C.L., F.R.S.; *Vice-Presidents*, The Vice-Chancellor of the University of Cambridge, Mr. W. T. Blanford, LL.D., F.R.S., Sir W. H. Flower, K.C.B., D.C.L., F.R.S., President of the Linnean Society (Dr. A. Günther), Professor E. Ray Lankester, LL.D., F.R.S., Professor A. Newton, F.R.S., Mr. P. L. Sclater, F.R.S., President of the Entomological Society (Mr. R. Trimen), Sir William Turner, F.R.S., Lord Walsingham, LL.D., F.R.S.; *Treasurers*, Professor S. J. Hickson, F.R.S., Mr. P. L. Sclater; *Secretaries*, Professor F. Jeffrey Bell, M.A., Mr. G. C. Bourne, M.A., Mr. A. Sedgwick, M.A., F.R.S., and a large general committee.

The Executive Committee, appointed by the General Committee at their meeting on November 4th, have now made the necessary preliminary arrangements for the holding of the Congress in August next. The Reception Committee hope to avail themselves largely of the facilities offered by the several colleges of Cambridge for the accommodation and entertainment of their visitors, while there is assurance that the more suitable of the public buildings of the University will also be placed at their disposal for the same purposes.

The International Congress of Physiology is to meet in Cambridge concurrently with that of Zoology, and certain arrangements will be made in common, though there is no intention of uniting the two Congresses, each of which will retain its distinct organization.

The Secretary has issued an appeal for funds that will be necessary to carry out the purposes of the Congress. Some members of the Executive Committee and others have already intimated their intention to make donations, and a list of these will be found below. Cheques should be sent to P. L. Sclater, Esq., F.R.S., or Professor Hickson, F.R.S., the Hon. Treasurers, at 3 Hanover Square, London, W.

DONATIONS ALREADY PROMISED.

	£.	s.	d.
Right Hon. Sir John Lubbock, Bart, M.P.	50	0	0
Hon. Walter Rothschild	50	0	0
A. Peckover, Esq	50	0	0
Sir William Flower, K.C.B., D.C.L., F.R.S.	25	0	0
The Lord Powerscourt	5	0	0
The Lord Walsingham, F.R.S	5	0	0
P. L. Sclater, Esq., F.R.S	5	0	0
Howard Saunders, Esq	3	3	0
R. Trimen, Esq	3	3	0

GENERAL.

HON. CARROLL D. WRIGHT, United States Commissioner of Labor, has received a cable dispatch announcing his election as a member of the Institute of France. He has also been elected an honorary member of the Imperial Academy of Science of Russia.

WE learn from the Philadelphia *Medical Journal* that a portrait of the late Dr. Theodore G. Wormley, professor of chemistry and toxicology in the medical department of the University of Pennsylvania, has been subscribed for by the students of the medical, veterinary and dental departments of the University, and by members of the faculty. It is to be formally presented to the Board of Trustees at the next commencement of the University.

THE subscriptions for the American University Table have been received from Brown University and from the Marine Biological Laboratory through Professor H. C. Bumpus; also from the American Society of Naturalists through the Treasurer, Professor Smith, amounting altogether to $250. They have been forwarded to Dr. Anton Dohrn.

ACCORDING to the *London Times* Mrs. Louisa C. Tyndall has written the following letter to Sir James Crichton-Browne, the Treasurer of the Royal Institution of Great Britain:

JANUARY, 1898.

DEAR SIR JAMES: As an expression of his attachment to the Institution, with which he was so long connected, and of his sympathy with its objects, my dear husband desired me (at such time as should be most convenient to myself) to present in his name to the Royal Institution £1,000, to be disposed of as the board of managers may see fit for the promotion of science.

I have now the pleasure of remitting to you this sum.

Yours faithfully,
LOUISA C. TYNDALL.

Sir James Crichton-Browne, in acknowledging the communication, says:

DEAR MRS. TYNDALL: I have to acknowledge your letter enclosing a crossed cheque of the value of £1,000. This generous donation to the funds of the Royal Institution, given by your late husband's expressed wish, will be notified to the managers and to the members generally at their next meeting, when a formal acknowledgment of their grateful appreciation of it will be communicated to you. Meanwhile, I trust you will allow me to express my own sense of the munificence of the gift, and of the simple and touching terms in which it has been conveyed. The managers would, I am sure, desire to be guided by any wish of yours as to the application of the gift; but, in the absence of any explicit directions, they will, I have no doubt, employ it in the promotion of that original scientific research in which your husband's vivid and penetrating intellect delighted to exercise itself. Revered as your late husband's memory is, and ever must be, in the Royal Institution, this posthumous mark of his solicitude for its welfare will, if possible, deepen the affectionate esteem in which he is held. There is not, I regret to say, in the Royal Institution any worthy presentment of the late Professor Tyndall. You have, I believe, an admirable bust of him by Woolner, and I should be glad to know if you would feel disposed to afford facilities for having a replication of that made for the Royal Institution.

WE regret to announce the deaths of Arthur Kammermann, astronomer, at Geneva on the 15th of December, at the age of 36 years, and of Dr. Oscar Stumpe, astronomer, at Berlin, aged 35 years.

THE thirtieth annual meeting of the Davenport Academy of Natural Sciences was held January 5, 1898. At this meeting the following honorary members were elected: Professor Henry S. Pritchell, Supt. U. S. Coast and Geodetic Survey, Washington, D. C.; Professor Robert Etheridge, South Kensington Museum, England; Dr. B. E. Fernow, Chief of the Division of Forestry, Washington, D. C.; Dr. John S. Billings, Director of the Consolidated Libraries of New York.

PROFESSOR LUCIEN M. UNDERWOOD, of Columbia University, lectured before the Philadelphia Academy of Natural Sciences on January 8th. The subject of the lecture was 'Our Native Fungi and How to Study Them.' A paper on 'The Law of Regression in Plants' was read by Professor J. C. Arthur before a recent meeting of the Minnesota Academy of Science at Minneapolis.

MR. B. E. FERNOW, Chief of the Division of Forestry, has been called to Hawaii to make a reconnoissance and to report concerning desirable forestry legislation.

BY the will of former Chief Justice John Scott, his estate, amounting to about $2,000,000, is to be held in trust for the benefit of his heirs until their death, when it is to go to the city of Bloomington for the foundation of a hospital.

DR. HERBERT HAVILAND FIELD writes from Zurich that the Zoological Bibliography has not yet received adequate support in the way of subscriptions in this country and is being conducted at a considerable personal loss. Save by Cornell University, there are no subscriptions either to the Physiological or the Anatomical Cards in the States of New York, Connecticut and New Jersey. The Sandwich Islands are better off, since Honolulu has three full subscriptions, besides several parts. This lack of support is

partly due to the fact that this valuable Bibliography, which is offered in either card catalogue or in sheet form with brief abstracts of the papers catalogued, has not been sufficiently advertised in this country. Although an international undertaking, it is largely due to the enterprise and scientific spirit of Dr. Field, and deserves the warm support of every institution in this country.

IT is stated in the *Bulletin* of the New York Public Library that the total number of periodicals and transactions of societies to which the library is subscribing, for the year 1898, is 2,502. Of these 483 are American, 497 British, 595 French, 660 German, 125 Italian, 36 Scandinavian, 27 Belgian, 16 Dutch and 12 Russian. During the calendar year ending December 31, 1897, the total number of volumes received by purchase was 16,098, and by gift, 10,128, making a total of 26,226. The total number of volumes catalogued and accessioned during the same period was 29,792. The number of pamphlets actually received during the year, by purchase, was 10,350, by gift, 40,247, and the total number catalogued and accessioned was 15,274. The total number of cards written during the year was 156,925. In addition to this, 15,404 slips from the printer were written, and for each of these slips five printed cards were obtained. The total number of cards in the Index Catalogue, which was open to readers, on the 31st of December, 1897, at the Astor Branch was about 80,000, at the Lenox Branch it was 27,800. The total number of readers during the year was 103,384, and the number of volumes called for by readers' slips, outside of those taken from the free reference shelves, was 304,466.

IN accordance with the directions of the Pennsylvania Fish Protective Association, the Executive Committee of that body has drafted and forwarded the following letter to President McKinley with respect to the appointment of a United States Fish Commissioner.

PHILADELPHIA, January 13, 1898.

To the President of the United States: The public press has recently announced a contemplated change in the office of the United States Commissioner of Fish and Fisheries. The Pennsylvania Fish Protective Association, fully recognizing the usefulness and high state of efficiency to which the work of this department of the government has been brought, would respectfully ask that, in making any appointment, due regard should be had to a compliance with the provisions of the statute providing for the proper qualifications of such Commissioner. We are, very respectfully,

E. HAGERT, *President.*
M. G. SELLERS, *Secretary.*

THE Cairo correspondent of the London *Times* writes: "The Egyptian government have abolished the important Fisheries Administration of Damietta and Lake Menzaleh, an antiquated institution under Levantine and native management, in which serious abuses had been discovered. In place of the former mode of collecting the revenue, by a duty on the fish caught, an annual tax is imposed on the fishing boats, and the alacrity with which this tax has been paid would indicate that the change is welcomed by the fishermen, though grave doubts are expressed lest unlimited license to fish uncontrolled by the teaching of science may result in depletion of the fishing grounds of Menzaleh, which comprise an area of 60,000 acres and are the resort of large shoals of salt-water fish. The new measure has involved the dismissal of Dr. J. C. Mitchell, scientific expert to the administration during 18 months and previously professor of zoology at the Ghizeh Agricultural College, who holds very complimentary testimonials from the Ministries of Finance and Public Instruction, also from her Britannic Majesty's Agent. It is to be regretted that government, in the present necessity for economy, cannot utilize his scientific attainments and fluent knowledge of Arabic in some other department. His abrupt dismissal after six years of good service has created an unpleasant feeling amongst the other officials who, like him, have accepted offers made by government, in the reasonable expectation that they were entering a permanent service."

THE Council of the Société d'Acclimatation has decided to issue, in addition to the Bulletin of the Society, a monthly journal which it is hoped will become the medium of communication between those interested in the objects of the Society. Great weight will be laid on the department of discussion, and the Secretary will

be glad to publish questions of a scientific or practical nature, the answers to which would not easily be found in existing publications. The journal will also contain announcements of the meetings of the Society.

THE Agricultural Department has issued a Farmer's Bulletin on the subject of forestry for farmers, by Mr. B. E. Fernow, Chief of the Division of Forestry. It contains articles in popular language regarding the growth of trees, the planting of forests, treatment of the wood lots, the cultivation of the wood crop, influence of trees, etc. The publication is a reprint from the year books of the Department for 1894 and 1895, and is issued in the present form because of the large demand for the information contained.

THE *Botanical Gazette* states that the collection of plants and literature made by the late Professor L. N. Johnson, of Ann Arbor, are offered for sale. Professor Johnson was especially interested in algæ, particularly the desmids, and has published a number of papers concerning them.

FROM the same source we learn that the complete herbarium of the late Mr. M. S. Bebb has been purchased by the Field Columbian Museum of Chicago, as also his letters, manuscripts, sketches, drawings, etc. The material of Mr. Bebb's own collecting was always known for its perfect preservation, but aside from the large general collection the special value of this purchase is to be found in the unique collection of salix material.

AT a meeting of the Fellows of the Royal Botanic Society of London held in the Gardens at Regents' Park on January 8th the Chairman, Major Cotton, congratulated the Fellows on the position at present occupied by the Society compared with its position a year ago. At that time the lease of the Gardens was about to expire, and there was an accumulated debt of some thousands of pounds. The debt, with the coöperation of the Council and of some of the leading Fellows of the Society, has since been paid and a new lease for the *maximum* term of 31 years has been promised by the Commissioners of Woods and Forests. The Gardens were opened for study to the students of the medical schools, and with the aid of the London County Council a school of practical gardening has been established. The Council of the British Astronomical Association were taking steps to erect and equip an observatory in the Gardens. Reference also was made to the great increase in the number of Fellows elected in 1897, there having been more than eighty above the average number of the last ten years. The receipt of a large number of donations to the library and museum was recorded, and a vote of thanks to the donors having been passed the meeting terminated.

AT a meeting of the Institution of Electrical Engineers, of London, on January 13th, Mr. J. W. Swan, F.R.S., the newly elected President, delivered his inaugural address, which took the form of a general review of the rise and progress of electro-chemical industries.

THE first general meeting of the Childhood Society of Great Britain, which was founded in November, 1896, was held in London on January 12th, Sir Douglas Galton, Chairman of the Society, presiding. It was reported that two courses of instructive lectures on the observation, study and training of children had been given. The Committee of the International Congress of Hygiene and Demography, appointed in 1891, having completed their work and issued a full report on 'the scientific study of the mental and physical conditions of childhood, with particular reference to children of defective constitution, and with recommendations as to education and training, based on the examination of 100,000 children,' handed over to the Society the balance of their funds in hand; also the published copies of their report, and all records of preceding work, which formed a most valuable basis of future research now in the possession of the Society. Dr. F. Warner stated that the Society had now records of 1,120 children who appeared to require special care and training, and a report had been prepared showing the grounds upon which the opinion that special care and training were necessary was formed. At the close of the meeting Sir Douglas Galton delivered the opening lecture of the session on 'Measures to be taken for the Care of the Feeble-minded.'

THE last issue of the *Monthly Weather Re-*

view contains an abridgment of an account given in *Das Wetter* of the celebration of the semi-centennial of the Royal Prussian Meteorological Institution. The jubilee festivities were divided into three parts: An address in Memorial Hall by the Director of the Institution, a visit of inspection to the Magnetic and Meteorological Observatories of the Institute, and a banquet in the hall of the Palace Hotel in Berlin. In his presidential address Professor von Bezold sketched the activity of the Institution during the whole period of its existence, showing the important part it had taken in the progress of science. The first Director, Mahlmann, held that office only a short time and was succeeded by Heinrich Wilhelm Dove, who, without controversy, elevated this meteorological institute to the highest position among all similar establishments throughout the world at that time. In the year 1885 the Institute was greatly enlarged and adapted to its new problems by the addition of the appropriate men of science. At the present time there are 188 stations of the higher class, 1,336 thunderstorm stations and 1,844 rainfall stations; scientific balloon ascensions on a larger scale than have hitherto been made also contribute material of the highest value for the study of the physics of the atmosphere. This material is reduced, analyzed and discussed at the Central Institute in Berlin; the distribution of meteorological knowledge is provided for by instruction at the University, given by members of the staff; the experimental investigations are conducted at the Meteorological and Magnetic Observatory at Potsdam. This latter institution, in connection with the astrophysical and geodetic institutions in the same locality at Potsdam, constitute altogether a microcosmos located, as it were, at a definite point on a line extending from the center of the earth outward to the stars. At the close of the address the great golden medal in science was presented to the Director of the Institute, von Bezold: the Order of the Crown (3d class) was given to Hellman, as Chief of the First General Division of the Central Institute; the Order of the Red Eagle (4th class) was bestowed upon Sprung, Chief of the Third or Instrumental Division and Director of the Meteorological Observatory; the Order of the Crown (2d class) was given to Vogel, Director of the Astrophysical Observatory. Professor Gruhn, of Meldorf; Professor Mohl, of Cassel; Professor Paszotta, of Konitz; the publisher, Alexander Faber, of Magdeburg, and, finally, Friedrich Treitsche, as proprietor of the Mountain Observatory, on Inselsburg, near Erfurt, received the Order of the Red Eagle (4th class).

THE number of applications for patents in Great Britain during 1897 shows an increase of 742 over the previous year and of 5,871 over those received during 1895. The number of patents applied for is not in itself a reliable index of the number of patents that may be issued. In the year 1896 of 30,194, 13,360 were completed, the rest being allowed to lapse after the nine months' protection. The inventions comprise every class of manufacture, but principally engineering.

THE *British Medical Journal* reports that Mr. Jonathan Hutchinson, F.R.S., intends to found a museum in his native town of Selby, in Yorkshire. Mr. Hutchinson has already established an educational museum at Haslemere, near which he has a residence, and here he has already a number of objects to spare, so that he hopes to be able to stock the new museum at Selby very rapidly. The new museum also is intended to be strictly educational, that is to say, it will contain objects calculated to convey knowledge to the less instructed, but at the same time it will not be confined to any particular subjects.

WE learn from the New York *Tribune* that the government at Ottawa has just instituted a change of policy regarding timber regulations applicable to the Northwest and Manitoba. Timber reserves will be maintained. With this object in view, the heavier timber belts will be withdrawn from settlement, and the young trees be preserved to provide a growth for the future. Guardians will be appointed to protect the reserves, particularly in the Turtle and Moose Mountain regions. Fires will be prevented, as far as possible, and the settlers will be restrained from cutting young trees. At the last session of Parliament a fund was voted for the institution of an efficient fire guard, and that will speedily be formed. At the summit

of the reserves mentioned are numerous lakes, and these are to be connected with wide roads, which, when completed, will, it is thought, form an effective obstacle to the progress of conflagrations.

UNIVERSITY AND EDUCATIONAL NEWS.

AT the semi-annual meeting of the Board of Trustees of Beloit College it was announced that the College had received a gift of $25,000 for the endowment of the chair of chemistry, now occupied by Professor E. G. Smith. The donor wishes to remain anonymous. It was also reported that the sum of $70,000 had been raised toward the $100,000 necessary to secure Dr. Pearson's gift of $50,000.

MRS. DANIEL C. EATON has recently given $2,000, the income from which is to be devoted to a scholarship open to competition by the graduate students of Yale University.

THE following assistants have been appointed in the Sheffield Scientific School of Yale University: C. B. Rice, in physics; W. G. Van Name, in biology: C. H. Warren and W. M. Bradley, in chemistry, and G. L. Bunnell, in zoology.

THE registration of students at the University of Pennsylvania for the year 1897–1898 is 2,834, an increase of 23 over the previous year. A decrease of 38 in the medical school is due to the raising of the requirements for admission. The officers of instruction number 258.

REPRESENTATIVE HAYES, of Lowell, has introduced into the Massachusetts House of Representatives a bill for a State appropriation of $100,000 to the Lowell Textile School, one-half of the amount to be paid in 1898 and 1900. At the same session Representative Dubuque, of Fall River, introduced a bill for an appropriation of $100,000 for the establishment of a school in that city upon the same lines as the one in Lowell.

DISCUSSION AND CORRESPONDENCE.

'WILD NEIGHBORS.'

EDITOR OF SCIENCE: A man who has been making books as long as I rarely 'talks back' to the critics. I never did so but once, and that was to rebut misstatements likely to injure the value of my property. For the same reason I beg leave to reply to your recent notice of my book 'Wild Neighbors' (The Macmillan Co., 1897), first thanking you for such commendation as is given.

Alluding to the fact that in order to round the biographies of the various animals treated, and make them interesting, I drew upon the writings of several 'well-known' naturalists, the reviewer so states this matter as to imply that the whole book is nothing but a mosaic of quotations, 'direct *and indirect*' (oh, fie!), and later frankly says that it 'offers nothing in the way of new and original matter.' It would be possible to produce an interesting and even valuable book in that way; but, if by the latter phrases quoted above it is meant that the book contains nothing of my own observation, I must protest. The chapter on Gray Squirrels distinctly states that it is wholly personal experience, and I have certainly seen on several occasions each of the other mammals described. As I did not write the book to laud myself, but to set the subject well before the reader, it did not occur to me invariably to put in the big I, yet I have not yet heard any complaint as to stolen goods.

Your reviewer alleges that 'many misleading statements are made,' and in support of this makes a very erroneous one himself. "The reader is told," he says, "that the Eastern Chipmunk (*Tamias striatus*) is now conceded to be the only species ranging between the Atlantic and Pacific coasts, while in reality some twenty-two species and twelve subspecies are now recognized in the United States." The reader is not told (by me) anything of the sort. He *is* told that the early naturalists, lacking large numbers of specimens, made several distinct species, so-called, of what are now conceded to be only geographical varieties of the single species *Tamias striatus*. There is a sort of sneer in the reviewer's next remark: "Young opossums are said to go about clinging to their mother's tails soon after they are born." That is not altogether a fair way of putting my account of it; but—don't they 'sometimes'? Credible persons say they do—Flower and Lydekker, for instance. Then the reviewer asserts that my 'nomenclature is out of date, a *large proportion* of the

generic and specific names differing from those in present use.' This, if true, would make me feel worse had I written a technical treatise instead of an untechnical one; but I should be thankful for a count of examples justifying this broad condemnation. All my names in classification (mainly relegated to the Index) are certainly as modern as the latest editions of Flower's 'Mammals' and Newton's 'Dictionary of Birds,' and are such as Dr. Elliott Coues and Dr. Theodore Gill thought proper for the Century and Standard Dictionaries. If they conform to these standard books of reference, and are rightly applied, I can safely say that if I had known (as possibly I did) of trinomial or other novelties of nomenclature more recently introduced by some specialist I would not have used them in a book for popular educational reading. The only reason for printing a technical name at all in such a book is that it may assist the reader in identifying the creature for further study elsewhere—an object that would be defeated unless a well-known term were quoted. If the reviewer had commented in this spirit upon this point, criticising the paucity, or what he considers the antiquated character, of such nomenclature as he found, I should never have alluded to it; but as he seems to bring it forward only as another symptom of general worthlessness, I deny the deficiency he reports.

A reviewer may combat my opinions or arguments or literary expression, and I shall be patient; or, if he can find real errors as to fact (as this one and others have done in noting a regrettable slip about the nuthatch) I shall be sorry and docile; but when he misstates my language, and resorts to innuendo instead of criticism, I shall resent it. First of all, a reviewer ought to try to understand the *purpose* of the book before him.

ERNEST INGERSOLL.

NEW YORK, January 8, 1898.

IN replying briefly to the above, let me begin by quoting verbatim what Mr. Ingersoll does say about the Eastern Chipmunk: "The chipmunk (*Tamias striatus*) * * * *, whose color and stripes exhibited so many varieties between the Atlantic and Pacific coasts that early naturalists having insufficient specimens described confidently as several species what is now conceded to be only one." But, as a matter of fact, the Eastern Chipmunk (*Tamias striatus* and varieties) does not range farther west than Iowa, while 22 distinct species are now recognized from the western United States. Since none of these are mentioned in the book, does not the author's statement imply that in his opinion *Tamias striatus* ranges across the continent and that all of the 23 species of chipmunks are now conceded to be one and the same?

In his reply to my criticism he attempts to put himself right by stating that the early naturalists 'made several distinct species, so-called, of what are now conceded to be only geographical varieties of the single species *Tamias striatus*.' But here he falls into another error, as he will himself discover if he attempts to hunt up the 'several distinct species' he imagines the early naturalists tried to make of this animal.

If the author had ever seen young opossums '*soon after they are born*,'—tiny, naked, helpless, blind, embryonic things, each clinging to a teat in the mother's pouch, where they are carried for a long period before sufficiently developed to even peep out of the pouch—he would hardly have ventured to assert that at this period they go about on the mother's back, clinging to her tail. The author implies that my criticism of his antiquated scientific names is based on his avoidance of 'trinomial or other novelties of nomenclature more recently introduced.' In this he is greatly mistaken, as a few examples will show. And it might be added, in spite of his remarks against the use of technical names in popular books, that he has himself, in the book in question, used the following, and all of them erroneously: *Hesperomys*, *Arvicola*, *Urotrichus*, *Synetheres*, *Sorex cooperi*, *Castor fiber*, *Canis lupus*, *Scapanus breweri* and others.

The trouble with the book, as a whole, is that it contains altogether too many loose and inaccurate statements. A book for 'popular educational reading' ought, above all things, to be reliable and to show a groundwork of scientific accuracy.

VERNON BAILEY.

WASHINGTON, D. C., January 21, 1898.

SCIENTIFIC LITERATURE.

Traité de Zoologie Concrète.—La cellule et les protozoaires. Delage et Hérouard, Paris. 1896. 527 pages; 870 illustrations.

This volume, the first of a series to be published by Delage and Hérouard, inaugurates a new departure in zoological text-books. The authors point out that the usual text-books (German and English) are not sufficiently definite and that the student, especially a beginner, has extreme difficulty in getting a mental picture of the animals which comprise any specific group. They maintain that the ordinary text-book, in dealing with such a group, introduces the subject by a few pages of comparative anatomy. The various organs and systems of organs are described for the group as a whole, but independently of any given animal, while exceptions to the common type are only casually mentioned. This introductory section is usually followed by an enumeration of the sub-divisions of the group and each subdivision is then treated in the same way as the group, beginning with the comparative anatomy, which is still vague and impersonal so far as the specific forms are concerned, and ending with a very short description of one or two characteristic genera. Nowhere in the chapter is any one animal completely described, and the student is confused by the variety of forms casually mentioned and bewildered by the numerous exceptions. Our authors regard such a text-book as 'abstract,' dealing neither with comparative anatomy nor systematic zoology but falling weakly between the two. In presenting their own 'concrete' zoology their aim is to avoid the evil above mentioned and to leave in the mind of the reader a complete mental picture of the structure of some type specimen of each group.

To take the place of the introductory sections of the usual text-books, they give a complete description of all the parts which make up a type specimen of the class or order in question. For this type specimen either some one form is chosen which represents the average of the group or an ideal form is created from the imagination. Such a form, whether imaginary or real, makes what the authors call the *morphological type* (Type morphologique). The description of this type specimen is very complete, comprising morphology, physiology, reproduction, regeneration, etc., while copious footnotes give further and more detailed information concerning special parts or historic connections. The description of the morphological type is followed by more condensed descriptions of the common genera, while the forms which are closely related are enumerated in footnotes. By describing so many they avoid exceptions to statements and so make the way clear to the student for every form or group of forms he reads about. Five hundred and thirty genera are actually described in the text, while half that number at least are mentioned in footnotes. Each genus is accompanied by a figure, sometimes colored, in which all of the parts are shown.

Fifty-eight pages are devoted to a general consideration of the cell and its functions. Here the structure, chemical composition and physiology of the cell, including nutrition, reproduction, fertilization, etc., are described in a general way, while extended footnotes give the main points on controverted questions in cellular biology. In this portion Delage follows pretty closely the lines of his own cytological researches, and when he deviates from them he is not always happy in his guide. For example, in his extended review of Fol's principle of the Quadrille of the Centers it is difficult to see why he ignores Wilson's complete disproval, and while cognizant of Boveri's and Mathew's work on the subject comes to the conclusion that Fol may still be right.

By far the largest part of the volume is devoted to the Protozoa (470 pages), and here we find their text-book plan completely worked out, although the simplicity of structure of the Protozoa gives little opportunity for testing the value of their color scheme, according to which the various organs are depicted in specific colors.

In the classification adopted the Protozoa are divided into the usual four classes—Rhizopoda, Sporozoa, Flagellia and Infusoria. The further subdivisions are only occasionally different from the usual classification. The authors follow Lankester in giving to the Mycetozoa the same taxonomic value as the Helioza and

Radiolaria. To be consistent, they should follow Haeckel, who has shown conclusively that the same reasoning which draws the Mycetozoa into the protozoan group would also draw the bacteria and fungi. This, however, they decline to do, and their classification of the Rhizopods is thereby weakened. The difficulty might have been avoided by introducing the questionable forms in an appendix under some name indicating their affinities to the plants. The same criticism might apply to their order Phytoflagellidæ. It is of value to show the connection of these plant-like forms to the Rhizopods and Flagellates, if for no other reason than to show the possible polyphyletic origin of Protozoa from Protophyta, but to make them equivalent to the well-defined animal groups seems to be a taxonomic error.

In classifying the Sporozoa the authors have left the beaten track and have taken advantage of the recent works of Labbé, Schneider and innumerable other investigators of this unfamiliar group to produce a new and apparently trustworthy classification in which the adult form is taken as the basis for the two main subdivisions—the Rhabdogeniæ (in place of Labbé's Histosporidæ and Cystosporidæ) and the Amœbogeniæ (equivalent to Bütschli's Myxosporidia).

One feature of the book which may be open to criticism is that nearly all of the figures taken from various special works are modified in some way to conform to the plan of schematization, and the reader is left with a feeling of uncertainty as to how much is real and how much imaginary, and he naturally questions the degree of accuracy with which the authors draw the line between the two.

Another and a more important criticism touches the plan of presentation which is to be followed throughout the series. While there is undoubtedly much of value in the idea of their 'concrete' zoology for teaching purposes, there are important reasons why the method they adopt cannot give complete satisfaction. For example, one cannot resist a feeling of disapproval upon seeing an *Amœba proteus* described and pictured with the long reticulate and anastomosing pseudopodia of the Foraminifera in addition to its own lobose type; nor, indeed, a 'hypotrichous ciliate with the musculature of a heterotrichous form.' Such a method may be very successful in forcing upon the student a general idea of the group described, but the picture which he carries away with him may be of some form which does not actually exist in nature, while with that mental picture he carries a number of others which show deviations from the morphological type. It may be asked, then, if the confusion of pictures which the student gets is not as bewildering to him as the confusion of facts and exceptions in the 'abstract' type of text-book?

Finally, this work, although of undoubted value for teachers and specialists, is designed as a text-book for beginners, but, putting aside all considerations of method and merit, the mere size of any zoology which begins with 470 pages on the Protozoa and which promises to fill a large number of volumes is out of reach of the student, and he must continue to seek a text-book, probably of the 'abstract' type, which is condensed, simple, interesting and scientifically accurate.

GARY N. CALKINS.
DEPARTMENT OF ZOOLOGY,
COLUMBIA UNIVERSITY, NEW YORK,
December, 1897.

Sleep: Its Physiology, Pathology, Hygiene and Psychology. By MARIE DE MANACÉINE (St. Petersburg). Contemporary Science Series. Imported by Charles Scribner's Sons, New York. 1897. Pp. 335.

This work, already published in Russian and French, now appears in English, enlarged and revised by the author herself. It is a brief and somewhat popular summary of the best that is now known about the physiology, pathology, hygiene and psychology of sleep. The author's own investigations supplement a very wide range of reading on the subject. A classified bibliography enumerates about 550 books and articles pertaining more or less directly to sleep.

The one constant physical accompaniment of sleep is arterial, particularly cerebral, anæmia, with venous congestion, particularly congestion of the vessels of the skin, with dilatation of the arms and legs. The plethysmographic experi-

ments of Patrizi, Hill, Mosso and others are reviewed. The internal organs, stomach, kidneys, etc., may be in full activity during profound sleep. As regards the nervous system the inactivity is found in the centers rather than in the nerve and cord. The brain is in a collapsed, pale condition. The special senses may any of them be active, while walking, talking, and other movements are not incompatible with sleep. Even the brain may be active in some of its parts.

The various theories as to the cause of sleep are discussed and criticised. The vasomotor theories find sleep to be caused directly by the withdrawal of the blood from the brain, or indirectly by the relaxation of tone in the vasomotor center controlling the skin vessels, producing dilatation of the latter and anæmia at the centers. The chemical theories attribute sleep to the impoverishment of oxygen in the brain, or to the poisonous presence of carbonic acid or of leucomaines. Some recent histological theories of sleep explain it by assigning certain amœboid characters to the cerebral cells or to the cells of the neuroglia, the retraction of the ramifications of these cells resulting in isolation and inactivity of the nervous elements. In place of any of these theories the author herself very naively substitutes a psychical theory based upon the formula: Sleep is the resting time of consciousness. Hence we notice that those in whom consciousness is feebly developed, savages, infants, less cultured adults, require more sleep than others.

Under pathology, the writer treats of insomnia, syncope, excessive sleep, hibernation, narcolepsy, catalepsy, hypnosis, latah and somnambulism. In all of these the discussion is brief and presents nothing striking. Under hygiene, attention is called to the dangers of too much sleep to persons of all ages. In children it develops the vegetative life of the organism at the expense of the central nervous system. In boys and girls it is apt to lead to albuminuria. In adults it enfeebles the brain. Likewise, the half-waking state, hypnosis, the use of alcohol or narcotics, are all injurious, as they tend to produce an enfeebled consciousness. We should rise late in winter and early in summer. In the case of children perfect uniformity in the time of retiring and rising should be avoided.

Under the psychology of sleep, dreams are treated at some length, as to their classification, causes and peculiarities. The strangeness of dreams, as well as the criminal nature that they sometimes assume, is accounted for by their atavistic character. In dreams our personal, fully developed consciousness is asleep, while latent tendencies transmitted by our farthest ancestors tend to revive. "A good and peaceful man may awake in horror with forehead bathed in sweat from a dream in which he has been transported into some strange and antipathetic environment in which he has committed a barbarous and cruel deed, not altogether abnormal, but fully possible in the far past of humanity."

G. T. W. Patrick.
University of Iowa.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES—SECTION OF BIOLOGY—MEETING OF JANUARY 10, 1 98.

Professor Osborn spoke as follows on the Origin of the Mammalia: Huxley's hypothesis (1880) deriving the Hypotheria or Promammalia from ancient Amphibia contrasts with Cope's (1884), which substituted carnivorous reptiles of the Pelycosaur type included in his order Theromora. Baur (1886) placed the Theromora as a parallel phylum with the mammalia springing from Sauromammalia of the Permian. Osborn (1888) proposed the Protodonta as archaic mammals transitional to reptiles, and later (1893) adopted Baur's views as to the Theromora. More recently Baur has removed the Pelycosauria from the Theromora entirely, and thus speculation by the late Professor Cope, Baur and Osborn as to the origin of mammals turns back to the true Theromora, namely, the *Dicynodontia* and *Theriodontia* of Owen, a group which Professor H. G. Seeley has described in his numerous memoirs. Among these Permian reptiles of South Africa we find a remarkable assemblage of characters which comparative anatomy and paleontology have led us to anticipate in the hypothetical promammal. Osborn (1888 and 1893) described the probable

dental and mandibular characters of the promammal, and from the investigations of Baur, Howes, Hubrecht, Beddard, Albrecht and others are derived, in the skeleton and soft parts, other characters which are largely amphibian.

A comparison of the *Dicynodontia*, *Theriodontia* and *Gomphodontia* (Seeley) shows that, while widely separated in dental characters, these reptiles are closely united in numerous osteological characters, which, in turn, distinguish them from all other reptiles, the most striking regions being the palate, zygomatic arch, expanded squamosal and correlated reduction of the quadrate, and the complex structure of the occipital condyle. Owen's definitions are too narrow for this group, which appears to be embraced only in Cope's larger definition of the Theromora. As is well known, the *Dicynodontia* throughout the skeleton abound in mammalian characters, and in the skull exhibit a combination of special adaptations to the greatly developed canine teeth with persistent reptilian and promammalian characters. The term *Theriodontia* should be restricted, according to Owen's original definition, to carnivorous types, such as *Cynognathus*, with triconodont molar teeth and typical promammalian dental formula. The characters of the skull, teeth, vertebræ, pectoral and pelvic arches and limbs on the one side show the affinities of these animals to the Dicynodonts, and, upon the other, make them appear prophetic of the Jurassic *Triconodonta*. The Triassic *Protodonta* are quite as primitive in dentition, but different so far as known in that the jaw consists of a single bone. The third group, or *Gomphodontia*, Seeley, embraces herbivorous types with grinding teeth of multitubercular and rudely tritubercular pattern. The latter fact is of great significance in the support it apparently lends to Osborn's hypothesis that the multituberculates are of trituberculate origin. In cranial characters these animals are as similar to the Theriodonts as they are dissimilar in dental characters, and since they include the genus *Tritylodon*, which was formerly placed among the Multituberculata, it appears possible that we have here a phylum more or less remotely related to the very ancient Mesozoic phylum of Multituberculata.

Summing up the Theriodont characters we find promammalian resemblances both in the form and formulæ of the teeth; in the terminal position of the anterior nares and structure of the palate; in the posterior expansion of the nasals; in the main infratemporal or zygomatic arch; in the great development of the squamosal and reduction of the quadrate; in the paired occipital condyles; in the intercentra of the cervical vertebræ; in the suturally united cervical ribs; in the intervertebral anterior dorsal ribs; in the Monotreme type of scapular arch (excepting, perhaps, the epicoracoid united by suture with metacoracoid); in the prescapular spine; in the powerful deltoid crest, large entepi- and ectepicondyles and entepicondylar foramina of the humerus. The limb and pelvic structure is evidence of a musculature similar to that of the hypothetical Promammalia, and of a body well raised above the ground and quadrupedal in position. As persistent reptilian characters may be cited the separate prefrontals, postfrontals and postorbitals and separate quadrate, which, according to Albrecht, is a reversional character in the Mammals; the separate transversum; distinct prevomer and complete pterygoquadrate arcade; the prominent basioccipital element; the separate elements of the lower jaw, and finally as adaptive or specialized characters are the several peculiar features in the back, skull and other parts of the skeleton. In conclusion, it appears that these true *Thermora* have the geological age required for the ancestors of the Mammalia. They are the only class of reptiles which exhibit mammalian affinities. They anticipate in the most surprising manner the dental structure of the ancient *Triconodonta* and *Multituberculata*. A most striking difference is found in their size, which far exceeds that of the oldest undoubted Mammals. This and certain specializations of structure bar any of the known *Thermora* from the ancestry of the earliest mammals, but do not preclude the existence of very small, unspecialized forms, which may have given rise to the oldest mammalian types. The existence of Amphibian structures, as observed by Hubrecht and others, in the placentation and soft anatomy of the mammals may be explained by the supposition that these Thermora retained certain Amphib-

ian structures from the ancestral Stegocephalia, which they transmitted to their descendants. The paired occipital condyle, however, upon which Huxley laid so much emphasis, is probably of secondary origin in this group, and not of direct derivation from the paired condyle of the Amphibians.

Dr. F. M. Chapman described the various types of vegetation and the altitudinal distribution of birds along the lines of the railroads running from the coast at Vera Cruz into the tablelands of the interior.

Professor F. E. Lloyd described the abnormal assimilative leaves produced by hypertrophy of scales on shoots of *Pinus ponderosa* after pruning of staminate shoots. The scales which subtend the fascicles so-called are the morphological equivalents of leaves.

Similar abnormal leaves are produced from the stump after cutting down the trees in certain species of Pine (*e. g.*, *Pinus rigida*). These have been regarded as identical with the primary leaves of the seedlings. The comparison of the hypertrophied scales under discussion with the primary leaves of species of Pine studied by Daguillon shows that they differ in certain details, and that they approach in structure to the *Abies* type of leaf which has peripheral ducts and double vascular bundles. The leaf of *Pseudotsuga* comports with this type, and the speaker suggested that the Pines may have been derived phylogenetically from a generalized form represented best among living genera by the genus *Pseudotsuga*, which combines the characters of *Abies* and *Picea* to a considerable degree. The exsert bracts are intermediate between these two genera, *Abies* and *Picea*, while the large seminiferous scales correspond more nearly to *Abies*.

These abnormal leaves of *Pinus ponderosa* must be regarded as atavistic, and are believed to be of pronounced value in the study of the phylogeny of the group.

GARY N. CALKINS,
Secretary of Section.

NEW YORK ACADEMY OF SCIENCE—SECTION OF GEOLOGY, JANUARY 17, 1898.

THE meeting opened with a paper by Mr. Arthur Hollick, entitled 'Further Notes on Block Island; Geology and Botany.' Mr. Hollick gave a summary of his work done on Block Island in July, 1897, and particularly of his success in tracing eastward from Long Island the Amboy clays which had previously been determined by paleontological evidence on Staten Island, Long Island and Martha's Vineyard. Something like fifteen species of Middle Cretaceous flora, nine of them typical of the Amboy clay, have been found. Mr. Hollick then classified the existing flora of theIsland physiographically into that of the hills, peat bogs, sand dunes and beaches, salt marshes and salt water. In the course of his work he added to the already published lists something like twenty-four new species, though it is not considered that this, by any means, completes the list of possible species that might be found in the spring. The flora, as a whole, is distinctly that of a morainal country, and its nearest analogue is that of Montauk Point.

Mr. Hollick then offered some suggestions to account for the present peculiar flora of the Island, and particularly for the absence of certain species that would be expected, and showed that two features are to be taken into consideration, the geological and the human. Block Island is the only part of the terminal moraine along the New England coast which does not have accompanying the moraine a certain amount of plain land, which would naturally allow a variety in the flora. It is presumable that Block Island also has been practically separated from the rest of the continent by a deep channel of more than twenty fathoms for a considerable time, and that even before the last depression of land the Island was connected to the mainland merely by a small peninsula, and hence the diversity of the flora as compared with the continent, because of the length of separation. The speaker also mentioned extensive archæological discoveries on the west shore of the Island, and gave a list of the shells and implements discovered in several of the kitchen middens, and also of the bones of animals brought to light in the old fireplaces in the sand dunes. He made particular mention, also, of the great number of Littorina, the common periwinkle of Europe, which has never before

been announced from Block Island. The paper was discussed by Professors Lloyd and Martin.

The second paper of the evening was by the Secretary, entitled 'Scientific Geography in Education.' The speaker brought out the point that geography work may be classified into three divisions—that for the common schools, the secondary schools and the universities—and outlined briefly a few suggestions as to how the subject-matter might be treated scientifically in each of the groups, and the dependence of each group upon the others. He paid particular attention to the difficulties of securing scientific work in geography in the grade schools, and to the fact that the present work is extremely unsatisfactory in most of our schools, probably because of the lack of inspiration, owing to the neglect of the subject hitherto in universities of the country. The paper was illustrated by a series of cheap and easily procurable maps that may be used for scientific geography work in either of the groups mentioned.

The meeting then closed with a few remarks by the Chairman in reference to the famous classic entitled 'Lithographiæ Wircenburgensis ducentis lapidum figuratorum, a potiori insectiformium prodigiosis imaginibus exornatæ, specimen primum,' written by Dr. Beringer and published in Würzburg in 1726. Professor Kemp summarized the work of the author in attempting to explain a great collection of pseudo-fossils from a theological standpoint, the fossils having previously been made by some practical jokers and buried in the rocks for the author to find.

RICHARD E. DODGE,
Secretary.

SUB-SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

AT the regular meeting of the New York Academy of Sciences at 64 Madison Avenue, Monday evening, January 24th, fourteen new names were proposed for membership. This is evidence of the increased interest being awakened in the Academy by the active efforts of President Stevenson. The hope was expressed that the number of members might soon be raised to five hundred.

The principle paper of the evening was presented by Mr. E. L. Thorndike, of Columbia University. He gave an account of a long series of interesting experiments on comparative psychology. These experiments were made upon cats, chickens, dogs, monkeys and other animals and were supplemented by the experience of professional animal trainers.

Cats were placed in boxes with doors so arranged that they could be opened from the inside in various ways, in one set of experiments by pressing a latch, in another by pulling a cord, by pulling a hook attached to a cord, or by turning a button. Again the arrangement was more complicated and two or three separate movements had to be combined in order to release the door and let the animal out to reach the fish placed outside the cage. Curves were given showing the rate at which the kittens learned the various tricks, the time taken to get out becoming gradually shorter.

The trick was always learned by accident; one lucky hit would prepare the way for another. There was no trace of rational inference. Seeing another animal do the trick a hundred times was no help. Nor was it possible to teach the trick by taking the kitten's paw and putting it on the latch and so opening the door, no matter how often it was repeated.

A habit once formed artificially will overpower natural instincts. A chicken that had been compelled to jump from a box to the floor in a roundabout way by a cardboard placed in its way felt unable to jump down to its food directly when the card was taken away.

The second paper was presented by Mr. H. I. Smith, of the Museum of Natural History. He gave an account of the archæological work which he did in British Columbia during the summer. He was the third member of the Jesup expedition, with Dr. Boas and Dr. Farrand. The work of the expedition has already been described in SCIENCE.

Dr. Livingston Farrand, of Columbia University, presented a brief report of the meeting of the American Psychological Association held at Cornell during the holidays.

CHARLES B. BLISS,
Secretary.

CHEMICAL SOCIETY OF WASHINGTON.

AT the fourteenth annual meeting, held January 13th, the following officers were elected for the ensuing year, viz.: President, Henry N. Stokes; Vice-Presidents, Peter Fireman, H. Carrington Bolton; Secretary, William H. Krug; Treasurer, W. P. Cutter; Executive Committee, the above and Charles E. Monroe, E. A. de Schweinitz, Wirt Tassin, W. F. Hillebrand.

V. K. CHESNUT,
Secretary pro tempore.

BIOLOGICAL SOCIETY OF WASHINGTON—285TH MEETING, SATURDAY, JANUARY 15.

THE major part of the evening was devoted to 'A Symposium on Recent Additions of Our Knowledge of the Cell,' the subject being introduced by Dr. Frank Baker, who gave a brief *résumé* of the successive discoveries in regard to the structure of the cell, touching on the theories of the alveolar and filar structures of the cytoplasm and dwelling at some length on the changes which take place in the nucleus during cell division.

Messrs. David G. Fairchild, Herbert J. Webber and Walter T. Swingle, who followed, presented the topic chiefly from a botanical standpoint, showing that the processes of nuclear and cell division were much more varied in plants than among animals, and might be very different, even taking place without the presence of a centrosome.

F. A. LUCAS,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met December 15th, one hundred and five persons present.

Professor W. M. Davis, with the aid of a series of lantern slides, gave a graphic account of excursions from the Atlantic to the Pacific. Some of the prominent physiographic features of parts of New England, Niagara, the Lake Superior Region, the Lake of the Woods, Lake Simcoe, the Black Hills, the Canadian Rockies and portions of the country along the Northern Pacific Railroad were described and illustrated.

A general meeting was held January 5th, forty-two persons present.

Mr. Frank Russell read some notes upon the Athabascan Indians, as observed in the neighborhood of the Great Slave Lake, on the Barren Ground of Canada. The men devote themselves to hunting, traveling in canoes and on snow shoes; the women are hard workers and, in addition to all the household duties, prepare the skins and make the garments. Personally the men are more cleanly than the women. Tattooing is not now practiced, and, under the influence of the Roman Catholic missionaries, polygamy has been abandoned; the Athabascans are Christians and Catholics. Mr. Russell also described many Athabascan songs, their music, the methods of camp making, and the celebration at Easter, and closed with a series of lantern views illustrating the physical type of the tribe, their dwellings and some of their habits and customs.

Mr. John Murdoch said that the canoes, as shown by Mr. Russell, were similar to those used on the Yukon.

SAMUEL HENSHAW,
Secretary.

NEW BOOKS.

Text-book of Physical Chemistry. CLARENCE L. SPEYERS. New York, D. Van Nostrand Co. 1897. Pp. vii+224. $2.25.

The Mathematical Theory of the Top. FELIX KLEIN. New York, Charles Scribner's Sons. 1897. Pp. 74.

A Short Handbook of Oil Analysis. AUGUSTUS H. GILL. Philadelphia and London, J. B. Lippincott Co. Pp. 139.

Chapters on the Natural History of the United States. R. W. SHUFELDT. New York, Studer Brothers. 1897. Pp. 472+Index.

A Primer of Psychology. EDWARD BRADFORD TITCHENER. New York and London, The Macmillan Company. 1898. Pp. xvi+314. $1.00.

A Description of Minerals of Commercial Value. D. M. BARRINGER. New York and London, Chapman & Hall, Ltd. 1897. Pp. 168.

A. Ecker's and R. Wiedersheim's Anatomie des Frosches. Revised by ERNST GAUPP. Braunschweig, Friedrich Vieweg und Sohn. 1896–7. Pp. xiii+229 and ii+234.

SCIENCE

FRIDAY, FEBRUARY 11, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

MEMORIAL OF THE FIRST HALF CENTURY OF THE SMITHSONIAN INSTITUTION.

THE Smithsonian Institution was established by a law signed by President Polk, on August 10, 1846, and on the approach of the fiftieth anniversary of this event the Secretary and the Board of Regents began preparations for its commemoration. It was deemed impracticable to summon delegates from the world-wide affiliated scientific institutions to an assemblage in Washington, and therefore it was decided, as the simplest and most effective means of celebrating the jubilee, to publish a volume containing an account of the history, achievements and present condition of the Smithsonian Institution.

Such is the origin of the superb work recently issued by the Institution; superb in its mechanical features, dignified in its plan, and of incalculable value as a record of a most remarkable outcome of the legacy of James Smithson. The editorial supervision of the book was at first placed in the hands of Dr. James C. Welling, a Regent, but his untimely death necessitated the selection of another, and it was confided to Dr. G. Brown Goode, the Assistant Secretary, who had already drawn up the original plan. Unhappily Dr. Goode died before the completion of the task, but the manuscript was so far advanced that the task was finished upon the lines laid down by him.

The work is divided into two parts; the first deals with the History of the Smithsonian Institution in a series of chapters by the officers, and the second part consists of 'Appreciations of the Work' of the Institution, in fifteen chapters, written by scientists not organically connected therewith.

Samuel Pierpont Langley, Secretary of the Smithsonian, contributes a biography of James Smithson, based upon official records and embodying results of investigations made in England in 1894. From these it appears that owing to an erroneous inscription on Smithson's tomb at Genoa, the date of his birth has been usually given inaccurately; a record in Pembroke College places Smithson's birth in 1765, eleven years later than that previously assigned.

Professor Langley gives a graphic sketch of Smithson's life and scientific publications, and reproduces his notable will, all of which is familiar ground to readers of SCIENCE. Smithson once wrote: "The best blood of England flows in my veins; on my father's side I am a Northumberland, on my mother's I am related to kings, but this avails me not. My name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten." This youthful ambition seems to have occurred to him at the time of making his will, for he bequeathed his property (under certain limitations) 'to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men.'

Smithson's monument is the Institution bearing his name; his grave at Genoa has been recently marked by a tablet placed by the Smithsonian, with an inscription naming him as its founder.

In a chapter on 'The Founding of the Institution 1835–1846,' Dr. George Brown Goode chronicles the events of the long period that elapsed between the receipt of the legacy by the United States in 1838 and the passage of the law establishing the Institution in 1846, during which plans of organization were discussed in Congress and in the press. A great university, an astronomical observatory, an agricultural school, a public library, a museum of natural history and geology, and other schemes, were advocated only to be discarded, and the final draft of the bill adopted was the result of a compromise. Dr. Goode points out the relations between the 'National Institution to promote science and the useful arts' and the proposed Smithsonian Institution; the former was founded in 1840 on a broad and liberal plan, and some of its members thought it ought to be custodian of the Smithson legacy. This was not sustained, but it is interesting to note that the Smithsonian Institution as finally organized followed quite closely the lines of the National Institution both as respects its superior officers and its list of objects.

Many influential persons contributed to the plan of organization. Dr. Goode points out that several of the most important features were due to Joel R. Poinsett, of South Carolina, viz.: The idea of an imposing and permanent building, the plan of a national museum with a staff of curators, the location of the Institution on the Mall, the main features of the Establishment, and the system of international exchanges of books. The library project was largely due to Rufus Choate and George P. Marsh, and the success in harmonizing the various plans that had been under discussion for ten years was due to Robert Dale Owen.

In the next succeeding chapter the same writer deals with the 'Establishment' and the Board of Regents, in an appendix to which Mr. William Jones Rhees gives concise biographies of the 129 distinguished persons who have filled the office of Regent.

A chapter of special interest is that on

'The Three Secretaries,' also by Dr. Goode. Joseph Henry, Spencer Fullerton Baird and Stephen Pierpont Langley are names indelibly grafted on American science, each occupying a distinct field. Henry's well-digested 'Programme of Organization,' the corner-stone of the edifice on which Baird built, has been often described. These sketches are written in a pleasing, forceful style, and contain biographies of the persons as well as their contributions to science and their labors for the Smithsonian Institution. That of the present Secretary contains details not easily found elsewhere.

Professor Langley writes of the 'Benefactors' of the Smithsonian, of which the most conspicuous is Thomas George Hodgkins, whose gift of $200,000 in 1891 created an epoch in the history of the Institution. The Hodgkins medals and prizes, recently awarded, and the capital prize to the discoverers of argon are well known.

The erection of the buildings and the care of the grounds are treated in a chapter by Dr. Goode. The corner-stone of the Norman building was laid May 1, 1847, and it was occupied in 1855, the structure having been paid for out of accumulated interest of the Smithson Fund. This fact is typical of the prudent management that has characterized the financial policy of the Secretaries and the Regents from the beginning, so that the present fund is double that of the original bequest of Smithson.

'The Smithsonian Library' and the 'Publications' are discussed in two distinct chapters by Dr. Cyrus Adler, and closely related to these is a chapter on 'The International Exchange System' by Professor William Crawford Winlock. These cover very fully what may be called the literary activity of the Smithsonian.

The idea of forming a great library was one of the earliest projects, even antedating the Institution itself, and at the outset a large proportion of the income was devoted to this feature; the transfer to the Library of Congress as a 'deposit' in 1866 was an excellent move, especially in view of the magnificent edifice in which the collection is now housed.

More than one of the writers pay high tribute to the learning and efficiency of the first librarian, Professor Charles Coffin Jewett, who filled the office from 1847 to 1855. The Smithsonian Deposit now numbers 357,000 books, pamphlets, periodicals and maps. The formation of this splendid library has been accomplished largely through the system of international exchanges, the magnitude of which is shown by the item that in 1895 107,118 packages weighing about 164 tons passed through the office.

The invaluable series of publications issued by the Smithsonian Institution has done more than anything else to elevate its position in the eyes of foreign savants. Dr. Adler, quoting Dr. Goode, points out that the value of the books distributed since the Institution was opened up to 1895 has been nearly one million dollars, being twice the original bequest of the founder.

Sixty-five pages of the handsome volume are devoted to the 'United States National Museum,' by Mr. Frederick William True, constituting an interesting record of this important department. Its formation from a nucleus contributed by the Patent Office and by the National Institute, its growth through results of explorations, and especially from the International Exhibitions held in 1876 and 1893, are herein described. The educational value of the great collections has been enhanced by the liberality of its Directors in sending duplicate specimens to institutions of learning, and especially by making displays of its treasures at the exhibitions held at London in 1883, Louisville in 1884, Minneapolis in 1887, Madrid in 1892, Chicago in 1893 and Atlanta in 1895. One of the results of

these periodical displays has been the revolutionizing of exhibition methods in the United States. Much space is given to reports of the Curators of the several departments and sections into which the Museum is divided; the larger divisions being as follows: Zoology, Botany, Geology, Anthropology and Arts and Industries. This chapter concludes with an account of the scientific publications of the Museum.

Dr. W J McGee contributes a graphic and vigorous essay on the history, policy and work of the 'Bureau of American Ethnology.' It clearly shows the immense value of the labors of the Bureau in collecting and preserving systematized knowledge of the North American Indians. Major J. W. Powell, the Director, found the science of anthropology young and scarcely developed when he took charge of the enterprise, and was obliged to devise methods of study as well as plans for making collections. The Bureau conducts explorations of mounds, studies in ethnology, archæology, pictography and linguistics of North America, and publishes four series of works which aggregate more than fifty volumes.

'The Astrophysical Observatory' is treated by its founder and Director, Professor S. P. Langley. The remarkable results accomplished in spite of a very inadequate environment with a small appropriation, first granted by Congress in 1891, testify to the industry and genius of its Director. The application of the spectro-bolometer to the examination of the infra-red spectrum is one of the topics discussed.

The youngest branch of the Smithsonian trunk, the 'National Zoological Park,' is described in a chapter by Dr. Frank Baker. The collection of animals for exhibition as museum specimens was supplemented by a collection of living animals which found temporary quarters in rude sheds behind the Institution building. From this small beginning was evolved the present fine park of 166 acres in a beautifully picturesque situation north of the city. In this park efforts are made to place the animals in congenial situations so that they may feel at home, so to speak. The collection includes herds of buffalo (bison), of llamas, of elk and of deer, as well as some valuable exotic animals. Owing to the insufficient appropriations by Congress this national enterprise has not made the progress hoped for by its founders, but the beginning is a good one.

Mr. Frederick William True writes of the 'Exploration Work of the Smithsonian Institution,' and a biographical sketch of George Brown Goode, by President David Starr Jordan, concludes Part I. of the volume.

The second part of the Memorial contains 'Appreciations of the work of the Smithsonian Institution,' divided as follows: Physics, by Thomas Corwin Mendenhall; Mathematics, by Robert Simpson Woodward; Astronomy, by Edward Singleton Holden; Chemistry, by Marcus Benjamin; Geology and Mineralogy by William North Rice; Meteorology, by Marcus Benjamin; Paleontology, by Edward Drinker Cope; Botany, by William Gilson Farlow; Zoology, by Theodore Gill; Anthropology, by Jesse Walter Fewkes; Geography, by Gardiner Greene Hubbard; and Bibliography, by the present writer. These reviews record the investigations carried on in the special fields named by officers and by those associated with the Institution, as well as the researches that have appeared in its publications. Credit is given to the individuals and to the Smithsonian, without whose aid many of the investigations would not have been undertaken.

Following these 'Appreciations' are three chapters as follows: 'The Cooperation of the Smithsonian Institution with other Institutions of Learning,' by Daniel Coit Gilman; 'The Influence of the Smith-

sonian Institution upon the development of libraries, the organization and work of societies and the publication of scientific literature in the United States,' by John Shaw Billings; 'Relation between the Smithsonian Institution and the Library of Congress,' by Ainsworth Rand Spofford. The mere enumeration of these descriptive titles explains the scope of the articles, and shows how fully the editor, Dr. G. Brown Goode, covered the entire field of the work within the Institution and its contact without during the first half century of its existence. In an appendix William Jones Rhees chronicles in order the principal events in the history of the Smithsonian. A full index closes the volume.

Twenty-four engravings and process-pictures of superior excellence are scattered through the book; they embrace views of the Smithsonian Institution and of the Hodgkins medal, with portraits of Smithson and of many of the Regents. As respects the typography, press-work, paper and binding no pains have been spared to make the book worthy of its subject. A small number of copies were bound in white vellum. For bibliographers the exact title is appended: The Smithsonian Institution, 1846–1896. The History of its First Half Century, Edited by George Brown Goode. City of Washington, 1897. Pp. x+856. Royal 8vo. Illustrated.

H. CARRINGTON BOLTON.

THE DIGNITY OF ANALYTICAL WORK.*

IT will doubtless be conceded by all that in the choice of the field to which one proposes to devote his life-work a number of things should be consulted. Among these may be mentioned not only mental capacity and the opportunities for training by courses of study which may be available to him, but also what may be termed natural inclination or love for the work. Just how much work should be given to each of these elements is a query not easily answered, but few will deny that genuine interest in or real love for the field of work chosen should be allowed as great sway as possible. Those of us who have gotten far enough along in our life-work to be able to look back somewhat, and to see and to differentiate the causes that have shaped our line of effort, know full well that circumstances beyond our control, rather than our inclinations and desires, have in many cases determined our course, but the fact nevertheless remains that for the best results, for the attainment of even moderate success, one's efforts must be in an agreeable field and his heart must be in his work. Fortunate is the man for whom circumstances so shape themselves that he is able to pass his years in the field of his choice and spend and be spent in work that is congenial to him.

Assuming now that, for most of us, circumstances and conditions have been such that we are spending our lives in the field of our choice, let us consider, for a moment, a tendency that seems to be a concomitant of those thus fortunately situated. Do we not occasionally find in ourselves a disposition to magnify the importance of the field in which we happen to be engaged? Are we not somewhat inclined, quite naturally perhaps, to think that our field of work is more important than that in which others are occupied? Does not the theoretical chemist, whose inclinations lead him to spend his time in writing reactions and building structural formulæ of wondrous architecture, often feel within himself that his work is on a higher and nobler plane than that of the patient analyst who has furnished the data which he uses? Does not the organic chemist who delights in the study of the carbon compounds, who can

* Presidential address delivered at the Washington meeting of the American Chemical Society, December 29, 1897.

repeat for you series after series of chemical bodies, differing from one another by the constant addition of an element, or group of elements, in whose vocabulary 'types,' 'substitution,' 'replacements,' 'condensations' and 'isomers' are familiar words, and who when a new organic compound is discovered cannot rest until he has found to what series and what place in the series it belongs, or what its relations are to other bodies in that marvelous structure, based on the element carbon, which the studies of the last half century have reared before our eyes—I say does not this organic chemist oftentimes feel that he is engaged in a field far more worthy of study, to which is due much more consideration, than to that of his inorganic brother who devotes days, and perhaps weeks, to unraveling the constitution of some obstinate silicate whose crystalline form gives little help, and whose oxygen ratio is hidden or obscure? Or, again, does not the physical chemist oftentimes think that, with the tools of his more especial field, with his specific heats, his vapor densities, his heat of chemical combination and his ions, he is quite competent to solve all problems worth solving in the realm of chemistry, and that those who are engaged in other lines are far below his standard and can be looked down upon with quite pitying sympathy? Still once more, do we not often see the pure chemist, whose battle cry is 'original work for the work's own sake,' claim for himself the highest seat in the synagogue, and refuse to join his efforts with those of others whom he regards as his humbler brethren, viz., those working in the field of applied chemistry, in securing the benefits of organization to extend and widen the borders of our science? Finally, not to make distinctions, do we not frequently see the analyst, who knows so well how necessary it is to have the trained and skillful hand and the acute and watchful brain both working together and at the same time, in order to secure the accuracy without which his work is worthless, claiming for his field that it is the foundation upon which our science rests, and that those who spend their time in locating the position of an atom in its molecule, or in finding the relations of an organic compound to other members of its series, or perchance in inventing long names for new compounds in which all the resources of the ancient Greek and Latin are brought to bear, to reveal in one word the constitution of the compound—I say does not the analytical chemist often regard these workers as unworthy to be called chemists?

Now, far be it from me to say that this partiality of each for his own field is blameworthy. We can, indeed, conceive of cases in which this partiality may be carried a little too far, but within proper limits not only is it not blameworthy, but even, as it seems to us, it may be praiseworthy for one to magnify the importance of the work in which he is engaged. A just and proper estimate of the value of his own work, a reasonable pride in his chosen science, or in that paddock of his science which it has fallen to the share of each to care for and cultivate, and indeed a moderate, though necessarily a somewhat partial, comparison of himself and his field of labor with others, even though that comparison is somewhat to the detriment of the others, are not always necessarily bad. On the other hand, such pride and such comparisons tend to stimulate to renewed activity, tend to sustain in the perplexities and discouragements of work, and tend to keep one's effort concentrated on the work which he can do best. Looked at in this light, the generous rivalry of one branch of our science with another, or the pardonable pride of each in his own chosen field, and even in his own work, may be a distinct advantage, and I know you will bear with me a few minutes, while I, with proper modesty and in the

true spirit, I hope, try to magnify a little the field of analytical work.

To my mind, then, it is just and proper to take pride in analytical chemistry, because of the power which a properly conceived and executed analysis has of explaining difficulties. A few illustrations will, perhaps, make this point clear, and I am sure I shall be pardoned for giving illustrations from my own experience, rather than historical ones.

Some years ago, after a passenger coach on the Pennsylvania Railroad had been through the hands of the car cleaners, it was noticed by some of the officers that the paint on the outside looked very badly, and had apparently been injured by the cleaning. A careful examination by the paint experts revealed the fact that the varnish was nearly all gone, and in some places the paint itself partially removed. As a matter of discipline, the car cleaners were called to account, and requested to explain why the paint and varnish had been so badly injured. Their reply was that with the soap that was furnished for car cleaning no better results could be obtained. This statement was, of course, received with a grain of allowance, it being well known to railroad operating officers that almost universally when anything goes wrong, and the men are called to an account, the materials are blamed. However, in order to give the men the benefit of the doubt, a sample of the soap was obtained and submitted to analysis, when it was found that this soap actually contained over three per cent. of free caustic soda and about seven per cent. of sodium carbonate. It is evident that this soap had been very carelessly made from cheap materials, and, since it is well known that water solutions of both caustic and carbonated alkalies are fairly good solvents for dried linseed oil and other constituents of paint and varnish, it is clear that the defense of the men, in this case at least, was legitimate and that the soap was really at fault. It may be added, for information, that the circumstances above described led to the preparation of a specification for common soap, in which the amount of free and carbonated alkali was limited to very low figures, and that no similar difficulty of destruction of paint and varnish has since occurred.

Another illustration from a different field will emphasize the power of an analysis to explain difficulties. A lot of boiler-plate was at one time received at the Altoona shops from one of the best makers. In this lot of forty or fifty sheets two were found which gave difficulty in flanging, this operation consisting, as is well known, in bending over the edges of the sheets while hot, nearly at right angles to the balance of the sheet, in order to enable it to be joined to other sheets in the boiler. The two sheets referred to cracked in the bend, although the remainder of the lot gave no difficulty from this cause. The workmen being thoroughly experienced, and the practices of the shop being excellent, the cause of the failure in the case of these two sheets was not apparent. An analysis of samples from each of these sheets, however, showed 0.35 per cent. and 0.36 per cent. of carbon respectively, while analyses of samples from other sheets in the same lot showed in no case above 0.12 to 0.15 per cent. of carbon. The explanation of the difficulty seemed now quite clear. The shops had been supplied for a long time with the softer grade of steel, and the methods and practices in use were those applicable to that kind of steel. No wonder, then, that with the harder grade difficulty should arise, as actually happened, and but for the analysis this might have passed into shop traditions as one of those unexplained and unexplainable crotchets of steel which both the makers and practical users of this metal delight in constantly bringing forward.

A single illustration further will, perhaps, suffice on this head. A few years ago a shipment of some three hundred freight axles was received at two different shops on the Pennsylvania Railroad, from an entirely reputable maker. Some of these axles were used for repairs, and some went under new cars. Scarcely had they gotten into service, however, before difficulty began to arise. The axles began to break. Indeed, one of them broke before the car had been turned out of the shop yard, one broke into three pieces before the car had made 150 miles, and in less than three months eight had broken. Each of the broken axles was sent to the laboratory, and a careful study of the case made, with the hope of discovering the cause of the failure. An examination of the freshly fractured ends of several of the broken axles showed that for a little distance in from the circumference the fractured steel presented an appearance quite different from that given by the remainder of the fracture. Moreover, a line of demarcation between these two apparently different kinds of steel in the same axle could be clearly traced. Accordingly, it was decided to make analysis of borings from near the circumference and near the center, and see whether this would reveal anything. It may be stated that the axles were known to have been made from Bessemer steel, and should normally have contained not more than 0.10 per cent. of phosphorus. The analysis of the borings from near the circumference of the axles in no case gave figures up to this limit, while the borings from the center of the axles in no case showed less than 0.16 per cent. phosphorus, and in some cases the amount was as high as 0.24 per cent. Those who are familiar with the methods in daily use in modern steel works will, from these figures, at once understand the cause of breakage of these axles. For the benefit of those who are not, it may be well to explain that in most modern steel works large ingots are now the rule, and that in large ingots, which take considerable time to solidify from the molten condition, analyses show that some of the constituents of the steel are not uniformly disseminated throughout the mass. This separation of the constituents during cooling, technically known as 'segregation,' is characteristic of the carbon, the phosphorus and the sulphur. Furthermore, the segregation appears to be worst in the upper third of the ingot, so much so that many specifications now require the upper third of the ingot to be removed, and not used at all in making the articles the specifications call for. This much being stated, it is clear why our axles broke. They were made from badly segregated steel, perhaps from the rejected upper thirds of a lot of ingots, the balance of which were used for other purposes. Subsequent correspondence with the parties furnishing the axles gave good grounds for belief that such was the case. For the comfort of those who ride on railroads, it may be added that the 300 axles were at once withdrawn from service, and that since that time a chemical and physical specification for both passenger and freight axles has been prepared which is believed to preclude the possibility of such axles as are described above being received by the Pennsylvania Railroad.

These illustrations of the power of an analysis to explain difficulties could be prolonged to almost any extent, but I spare you. Furthermore, I should not like to be understood as claiming that every puzzle, every difficulty or every state of affairs in nature where the reasons for the phenomena which we find are not apparent at sight can be explained by a chemical analysis. Our knowledge is far too limited for this. Moreover, many cases could be cited in which an analysis throws no light whatever on the situation; but, notwithstanding this, an experience of some twenty

years in seeking out the causes of things, as a necessary preliminary to the intelligent modification of practices and methods in connection with a great corporation, has continually impressed me more and more with the very great help which a properly conceived and executed analysis can give in cases of difficulty.

But, again, I take pride in the field of analytical work, because of the opportunity which thoughtful analytical work affords for finding new things. The careful, thoughtful, observant analyst is constantly on the verge of either being able to add to his own knowledge or of being able to contribute something to the general progress of our science. And here, again, I must be pardoned for using as illustrations cases which have arisen in the laboratory of the Pennsylvania Railroad Company.

A few years ago, in our laboratory, we began to get ready to make our analyses of the samples of steel which were designed ultimately to be the international standards for the analysis of iron and steel. Before starting in on these samples, however, it was deemed prudent to do a little preliminary work on some other samples, with the idea in mind of seeing whether apparatus and method were satisfactory. Accordingly, four separate and distinct determinations on the same sample were made for carbon, using the double chloride of copper and ammonium to release the carbon, and burning in oxygen gas. The four determinations agreed with each other within 0.01 or 0.02 of a per cent., and were regarded as fairly satisfactory. But as the work was important, and as some parts of the apparatus had not worked quite satisfactorily, it was decided to repeat the four determinations. Meanwhile a new stock bottle of solution of the double chloride had been made exactly in the manner that had been our custom for some time previous. When the second four determinations were obtained they differed from the first by more than a tenth of a per cent. I need not weary you with the details of our hunt for the cause of this discrepancy, how every point in the apparatus was tested one after another, how various modifications were tried, how combustions were made on crystallized sugar to check ourselves, and how finally we located the difficulty in the double chloride of copper and ammonium solution. These details have all been published.* Suffice it to say that, as the result of this work, together with subsequent work by other chemists, it is, we believe, now generally accepted that the commercial ammonium double salt contains carbon in some form, probably pyridine, that its use as a solvent to release the carbon from iron and steel is unreliable, and that the substitution of the potassium for the ammonium double salt overcomes these difficulties. The point which I especially want to emphasize is that, in trying to do a little careful analytical work, we struck a new and apparently hitherto unsuspected source of error in one of the oldest and best established methods of iron and steel analysis.

Another illustration will, perhaps, make this point still more clear. In the regular course of work, at one time a silicon determination was made in a piece of tire steel which had been sent by an officer of another railroad for information. The figures found by our analysis were 0.14 per cent., these figures being sent to the officer above referred to. A little later word was received that an analysis of a sample from the same tire by another chemist gave 0.28 per cent. as the content of silicon. This, of course, led us to look over our work, with the idea of finding where the cause of the discrepancy lay. A careful examination of our weights and figures showed that it was not an error of calculation. Accordingly, we decided to duplicate our work, need I

* *Trans. A. I. M. E.*, 19, 614.

say, with the expectation of finding that the other chemist had made a mistake? Judge of our surprise when we found that our second analysis confirmed his figures exactly. Our first and second analyses had been made by the same method, and by the same operator, working on borings from the same bottle, and the cause of the discrepancy between the two was not, therefore, at first sight apparent. On carefully questioning the operator, however, as to exactly what he did at each step of the method, a clew was obtained, which, when followed out, cleared up the whole difficulty and ultimately led to a modification of the method. The silicon in these samples was determined by what is known as Drown's method, which consists in dissolving the steel in nitric acid, adding sulphuric, heating until white fumes of the latter acid appear, to render the silica insoluble, dilution with water, filtration, washing and weighing. The difference between our two analyses consisted simply in this, that in the first case, after the dilution with water, there being considerable work in hand, the vessel was allowed to stand overnight before filtration, while in the second case filtration immediately followed dilution. Subsequent work on this point showed that in this method silica is not completely dehydrated by heating in concentrated sulphuric acid in presence of iron salts, but is apparently rendered colloidal and sufficiently dehydrated, so that if filtration follows soon after dilution fairly accurate results will be obtained. On standing after dilution, however, this colloidal, undehydrated silica, apparently goes into solution again. Indeed, we were able to get on this same sample, anywhere from one-eighth up to the full amount of silicon present, by varying the time of standing after dilution, the longest time covered by our experiments being about four days.

Perhaps I may venture to give you still one more illustration of how, in the course of analytical work, new and apparently hitherto unnoticed reactions may be hit upon and modifications of methods result. Every chemist who has done much work in determining phosphorus in iron or steel, by the reduction of the molybdic acid of the yellow ammonium phosphomolybdate and subsequent titration of the reduced solution, cannot fail to have been annoyed by the occasional failure of duplicates to agree. Apparently, in the two analyses everything has been done exactly alike, and yet the results do not agree. Every thoughtful chemist cannot fail to have felt at such times that somewhere in the method there were conditions affecting the result that were not fully controlled. During the last six or eight months in our laboratory we have apparently struck one of these hitherto uncontrolled conditions, whose influence is not large, and yet enough at times to cause annoying discrepancies in duplicates, or between different chemists working on the same sample.

In order to make clear what follows, it should be stated that in the ordinary working of this method the yellow precipitate, after careful washing, is dissolved in ammonia, and this solution is then treated with sulphuric acid largely in excess and diluted to a definite volume, in which condition it is passed through the reductor and subsequently titrated with standard potassium manganate. The reductor in common use consists, as is well known, of a tube of heavy glass, about five-eighths of an inch internal diameter, and about a foot long, filled with powdered zinc, the top being fitted with a funnel, and the bottom with a stopcock. Below the stopcock a smaller tube carries the rubber cork by means of which the reductor is fitted to the flask which receives the reduced solution. This smaller tube usually projects into the flask an inch or two, and it is customary to

use the pump to draw the liquid through the reductor. This much being premised, we may say that in a communication from Mr. Porter W. Shimer, one of the members of the Sub-Committee on Methods of the Committee on International Standards for the Analysis of Iron and Steel, he, among other things, called attention to the fact that when making a number of determinations on the same sample, all other things being the same, he got a reduced solution that required more permanganate if he prolonged the small tube below the stopcock in the reductor, nearly to the bottom of the flask, than if this small tube projected only an inch or two into the flask. This statement brought afresh to our minds a thought that every one who has worked much with molybdic acid must have had: viz., that reduced molybdic acid is very easily reoxidized. We accordingly determined to find out, if possible, whether this was actually the case, and, if so, how much this difficulty might amount to. Accordingly, a stock solution of ammonia molybdate dissolved in water was prepared, and a number of aliquot parts of this solution measured out. Now, obviously, there are two chances for the reduced solution to become oxidized by exposure to the air. One of these is from the air in the flask during the reduction, and the other from the outside air during the titration. Without going into minute detail, it is, perhaps, sufficient to say that when we reduced an aliquot part of our stock solution, using the short tube of the reductor and adding the permanganate drop by drop, with continual agitation during the whole titration, we used 22.7 cc. of our standard permanganate, all figures given being a mean of a number of closely agreeing determinations. When now we made the reduction the same as before, viz., with the short tube of the reductor, but titrated by allowing about ninety-five per cent. of the permanganate required to run into the flask before agitation at all and finishing the titration drop by drop, we used 23.1 cc. of permanganate; in other words, so sensitive is a reduced solution of molybdic acid that it is easy by varying the mode of titration to introduce considerable error. Prolonging now the tube at the bottom of the reductor as suggested by Shimer, which would result, as is apparent, in a diminished exposure of the reduced solution to the air in the flask before titration, we found our aliquot part to use up 23.6 cc. of permanganate. But even with the prolonged tube there is some exposure of the reduced solution to the air during the reduction. Accordingly, on the suggestion of my principal assistant, Mr. F. N. Pease, we put a measured amount of standard permanganate solution into the flask which was to receive the reduced solution, more than sufficient to react with it, and then prolonged the tube from the reductor, to dip below the surface of this permanganate. Obviously, with this arrangement the reduced solution is entirely prevented from air exposure. On making the reduction and titrating the excess of permanganate with standard solution of ferrous sulphate, it was found that the aliquot part had now used up 24.1 cc. of permanganate, an extreme difference in amount of permanganate used under the varying conditions described, of nearly six per cent. Obviously, if two chemists were working on the same sample of molybdic acid, one employing the manipulation first described, and the other that last described, the discrepancy between them would be serious. The discrepancy on phosphorus in steel, while the same in percentage, is very much smaller in actual figures, but still enough to be annoying. The work above referred to is not yet quite finished, but enough has already been done to demonstrate that the ordinary method of determining phosphorus in steel can be advan-

tageously modified in the interests of greater accuracy; and also, although not yet rigorously demonstrated, there are strong indications that molybdic acid (MoO_3) is always reduced by zinc to Mo_2O_3, and that the more complex formulas, $Mo_{12}O_{19}$, $Mo_{24}O_{37}$, etc., so commonly given as representing this reduction, simply mean that the conditions under which these formulæ were obtained permitted the reoxidation of the reduced solution to the extent indicated.

There is another phase of this question we are discussing: 'The Dignity of Analytical work,' which will, perhaps, bear a few words. It seems to be universally conceded that the brain that plans and guides is worthy of more honor than the hand that executes; the general deserves more than the private soldier; the architect than the builder; the investigator who plans the work than the chemist who makes the analyses. Few will object to such a distribution of rewards as this, and certainly no one will claim that a chemist who, machine-like, simply follows directions, without thought or interest in the matter, can fairly claim recognition for anything more, perhaps, than manipulative skill and honesty. But, on the other hand, it is fair to say that such analysts can truly be called analytical chemists. Does not the genuine analytical chemist embody within himself, not only the capacity of brain to wisely plan his method of attack, to conceive which one of the possible reactions in the case it will be best to employ, but also the requisite manipulative skill, to carry out the line of action decided upon. To my mind, these two things, viz., the brain power necessary to plan the work, together with continual activity of the brain while the work is going on, and the skilled and trained hand requisite to do the work, are necessarily coexistent at the same time in the good analytical chemist, and woe be to that chemist who tries to put them asunder. The analyst whom chance or the exigencies of earning his livelihood have thrown into a situation where day after day he must, for a time at least, do the same thing over and over again, and who does not, even in this situation, use his brain constantly, does not each time he adds a reagent think what is going on in the beaker; does not each time he washes a precipitate think what he is washing out; does not every time he makes a weight take a genuine interest in the result, and even the hundredth time that he makes the same determination is not on the lookout for some flaw in the method he is using, or some possible new reaction in connection with it—such an analyst, I say, will stand a good chance to remain a routine chemist all his life.

On the other hand, what shall we say of those chemists who plan out a line of investigation and are content not to make the necessary analyses themselves? We are quite well aware that at the present time this is a very common method of making investigations, and we can, of course, understand that pressure of other duties may make it impossible to pursue investigations in any other way. But we cannot regard this state of affairs as, to say the least, anything less than unfortunate. If we may trust our own experience, the time spent in making the analyses required by one line of attack on a stubborn problem is most valuable, in the opportunity which it affords for carrying the problem in mind, and planning out other lines, in case the one in hand does not succeed. Moreover, still more valuable is it to make the analyses yourself, in that while doing so you so frequently get suggestions from the work that are the very ones upon which final success depends. I wish there were time to illustrate this point as its importance deserves, but the history of chemistry and your own experience will have to furnish

them to you. To our minds it is hard to overestimate the importance, especially to a young investigator, of his doing his own analytical work for himself. If we read rightly, this was the almost universal habit of the old masters of our science, and we greatly fear that those chemists who from choice delegate their analytical work to others will find, after years of such delegation, that their reward of successful investigations is very small.

A single thought further. At the present time so much applied chemistry is either based on analytical work, or has analytical work as an almost essential constituent of its existence, that in a paper discussing analytical work a few words may not be amiss on the relations between pure and applied chemistry. Without wishing to touch in the slightest degree on mooted or disputed questions, it may not be unfair to say that, while the applied chemist does truly, as the name indicates, in the mass of his work, utilize or apply the discoveries of others to useful effect, it does not at all follow that in the field of applied chemistry no discoveries yet remain to be made. It is certainly not too much to say that no thoughtful chemist has ever worked for any length of time in any field of applied chemistry without finding himself surrounded with problems involving new and unknown reactions; with problems, am I not safe in saying, requiring for their solution as good appliances, as deep study and as keen thought as any that occupy the minds of the pure chemists. These problems continually force themselves upon him, and his only regret in the matter is that the time at his disposal does not permit him to solve them as fast as they arise. A prominent feature of these problems in applied chemistry is worthy of close attention, viz., they generally have immediate useful applications as soon as they are solved. The applied chemist usually makes an excursion into the unknown, because some difficulty has arisen in the course of his regular work, or because some new, more rapid, or more economical method of accomplishing results is desired. He may succeed in finding a new reaction or in utilizing an old one, as the basis of a successful commercial process, or in modifying a manufacturing method in the interests of both economy and speed. But whatever his work, the immediate useful application of the information he secures is both his stimulus and guide. He may not be able, from lack of time, to follow his work up, and find the complete relations of the facts ascertained to the other branches of chemistry, but this is his misfortune rather than his fault, and this condition of affairs, viz., being unable to follow out to completion lines of research one started on is, if we understand the matter rightly, not characteristic of the applied chemist alone. This much being said, let us ask in what respects the pure chemists resemble or differ from those who work in the field of applied chemistry.

They certainly are alike in this, that neither of them can devote his whole time to original work, but both must devote no small portion of their energy to other lines than making investigations. There may have been a time in the history of chemistry when investigators were so fortunately situated that they could devote their whole time and energy to finding out new truth and giving their results to the world. All honor to such investigators. Moreover, we all know that occasionally an appropriation of funds or an endowment is made for research in some special field. But truly, would it not be too much to say that the work of any large percentage of the pure chemists of to-day is the result of any such fortunate circumstances? Furthermore, the pure and applied chemists are alike in that in their original work both

are seeking for the truth, and if they are successful both are adding to the sum of human knowledge.

They differ, as it seems to me, principally in this: First, the researches of the applied chemists being largely made in the interests of corporations or manufacturing establishments, the results of these investigations in many cases are not at once available to the world, except in so far as they lead to diminish cost of production. Those who have paid for these researches naturally feel that they should be allowed a period of time at least to recoup themselves for their expenditures, and so they protect themselves either by patents or secrecy. But this is only a knowledge of the truth deferred. Sooner or later the results of the investigations of all applied chemists are added to the great body of accumulated chemical knowledge. The pure chemist, on the other hand, at once gives the results of his investigations to the world, and is quite content if the publication of his researches shall bring him as his reward a modicum of appreciation from his fellows. Second, in their original work, the pure chemists differ from the applied chemists in the ulterior purpose for which the investigation is undertaken. As has already been stated, the applied chemist usually undertakes an investigation, tries to find new truth with the avowed purpose of at once utilizing this truth as soon as it is found. Not so the pure chemists. The problems which they attack and solve so successfully have no necessary relation to subsequent utility. The truth which they discover and put on record may be found to be useful at some time, but its possible immediate utility or non-utility is not taken into consideration by the pure chemist, either in his choice of a subject for investigation or in the prosecution of his work. The truth for the truth's own sake is his motto and guiding star.

If we have diagnosed the case correctly, then, the principal differences between the pure and the applied chemist are that the latter withholds the results of his work from the world for a period of time, while the former gives his at once, and that the latter is, in his original work, seeking for truth that is useful as soon as it is worked out, while the former neither knows nor cares whether the truth that he discovers is either now or at any future time turned to practical or useful effect. Let me not be misunderstood. I am not attempting to belittle in any sense the work of the pure chemists. They are worthy of all honor and respect. But, on the other hand, I am not at all willing to have the work of the applied chemists made light of, or treated as though it were in an inferior field. To my mind there is no occasion for either to belittle the work of the other. The field of chemistry is so broad, the amount of unoccupied ground in every branch of the science is so great, that there is neither time nor energy for struggling as to who is greatest or who is least, but in whatever line a man's tastes, opportunities or the force of circumstances may lead him, whether as a pure or an applied chemist, whether organic or inorganic, whether theoretical, physical or agricultural, whether analytical or synthetic, provided in his mind at all times the love of truth is above all, and honest work is being done, he is worthy of recognition, honor and respect.

C. B. DUDLEY.

ALTOONA.

THE AMERICAN MORPHOLOGICAL SOCIETY.

THE eighth annual meeting of the American Morphological Society was held at Cornell University, Ithaca, N. Y., December 28th, 29th and 30th. The following new members were elected: Professor J. H. Comstock, Cornell University; Mr. Ulric Dahlgren, Princeton University; Professor

Pierre Fish, Cornell University; Miss Catharine Foot, Evanston, Ill.; Mrs. S. P. Gage, Cornell University; Professor S. H. Gage, Cornell University; Professor C. W. Hargitt, Syracuse University; Dr. B. F. Kingsbury, Cornell University; Professor E. W. McBride, McGill University; Dr. P. C. Mensch, Ursinus College; and Professor A. D. Morrill, Hamilton College.

The following papers were presented and discussed:

On Reading the Records of Evolution in the Wings of Insects. J. H. COMSTOCK.

THIS was an illustration of a method of taxonomic work outlined by the writer several years ago in an essay entitled 'Evolution and Taxonomy,' where he urged a more constant use of the theory of evolution than is customary in work of this kind. It was suggested that, as the structure of a highly organized animal or plant is too complicated to be understood in detail at once, the student begin with the study of a single organ possessed by the members of the group to be classified, and determine its primitive form and the various ways in which this has been modified. The data thus obtained will aid in making a *provisional* classification of the group, which should be confirmed or corrected by a similar study of other organs.

The illustration given in this paper was an effort to obtain data bearing on the working-out of the phylogeny of the orders of winged insects, by a study of the characters presented by the venation of the wings, the homologies of the *anlagen* of the winged-veins, *i. e.*, the tracheæ that precede them in nymphs or pupæ, were determined, and a hypothetical type representing the arrangement of the tracheæ in the nymph of the stem form of winged insects was figured. It was then shown how this type has been modified in the different lines of descent; in some by a reduction in the number of wing-veins by a coalescence of adjacent veins; in others by the development secondarily of supernumary veins. Each of these processes can be observed by a study of the ontogeny of certain species representing the line of development in which it occurs, and also by a study of allied forms in which it has taken place in varying degrees.

The Records of Evolution in the Wings of Dragon-Flies. J. G. NEEDHAM.

THIS paper furnished a concrete illustration of the method outlined in the preceding one. The adult dragon-fly wing was compared with the typical insect wing and was seen to differ widely from it, but the arrangement of the tracheæ in the budding wing of a young nymph was shown to be nearly that of the type. The development of the complex adult venation was then traced in the development of the tracheæ of the nymph, and it was seen that these tracheæ show what was the primitive condition of every feature of the venation.

The *triangle* was selected for an illustration of the reading of the dragon-fly record, and it was shown that primitively this differed little from an ordinary rectangular oreole, while with the adaptation of it to the bracing of the basal part of the wing every part of it has been modified along certain definite lines, which can be clearly traced. Some of these lines of development were illustrated by series of figures. It is stated that the *triangle* is but one of many correlated wing characters, that specialization has taken place along many different lines, and that almost every wing has preserved in some of its parts a bit of the ancestral record. In conclusion, attention was called to the greater value of conclusions based on a true genealogic study of a single organ than of those based on the mere assortment of characters at large.

Some Grafting Experiments upon Lepidoptera. H. E. Crampton, Jr.

The writer described a series of experiments carried on during the spring of 1897, preliminary to a full series now in progress. The operations were performed on pupæ of the commoner Saturniidæ: *P. cynthia*, *S. cecropia*, *C. promethea* and *T. polyphemus*. They were designed to determine, if possible, besides the coalescence power of fragments or nearly complete pupæ, as well the color effect, if any, of each component upon the other. As shown by Mayer and others, the pigmental colors are produced by the chemical decomposition of the blood in the empty scale cells; and, therefore, if two specifically different forms were coalesced, reciprocal color-effects might be looked for.

Photographs and specimens illustrating the types of operations, as well as some coalesced imagines, were exhibited. The first group of operations included homoplastic and heteroplastic unions in natural proportions of anterior and posterior halves of pupæ. Four out of sixty-one furnished metamorphosed imagines, with the parts perfectly coalesced. A hinder part of the abdomen of a *promethea*, fused to a *cynthia*, showed a buffy color, with no trace of its specific red color.

'Tandem' unions formed the second group. In these, two pupæ, one deprived of its head and the other of the posterior part of its abdomen, were joined. Three out of twenty-seven operations proved successful, producing compounds with four pairs of wings, six pairs of legs, etc. In heteroplastic operations no *definite* abnormal color-effects were observed.

'Twin' unions afforded fourteen pairs of coalesced imagines from a total of sixty-nine operations. Head to head, back to back, tail to tail, and other unions were obtained. No pairs among the heteroplastic operations showed any reciprocal color-effect whatever.

Regeneration in Planaria maculata. T. H. Morgan.

The remarkable power of regeneration of Planarians has been known for a long time. The more recent results of Van Duyne and Randolph have added many new facts to those already known. The following account gives a few additional observations and experiments to those previously published. If the planarian (*Planaria maculata*) is cut into cross-pieces all the pieces make new worms unless they be too small. The piece in front of the eyes does not seem to be able to regenerate. Other experiments show that this piece is near the linear limit of size below which a piece does not regenerate. In the more anterior cross-pieces the new pharynx appears near the posterior end of the piece; in the more posterior pieces the new pharynx appears in the middle of the piece, and in the last piece the new pharynx appears in the middle of the old tissue. Longitudinal pieces cut from the side of the worm, generally form new long worms with the pharynx along the line between the old and new tissue, sometimes, however, in the old tissue. The new median line is often along the middle, or a little to one side of the middle, of the old tissue. Not infrequently these long pieces from the side develop differently. They shorten and become crescentic in shape, with the cut edge in the concavity of the crescent. Along the new edge new tissue develops and completely fills up the crescent. This new tissue soon develops into a head, with eyes and brain. The median plane of the new animal is at right angles to that of the original worm. These pieces never elongate, since there is an unbroken ectoderm behind, that originally formed the side of the worm.

Other experiments showed that almost any part of the old tissue had the capacity to form a new pharynx, but the head with

its eyes and brain, etc., never formed out of old tissue, but always from new tissues.

In one case two heads formed on opposite sides of a short cross-piece that had been cut from the middle of the body. The head, therefore, had the normal orientation of the piece, while the other, turned in the opposite direction, had its orientation exactly reversed.

Regeneration and Grafting in Cordylophora. G. LEFEVRE. (Presented by E. A. Andrews.)

THE stems of Cordylophora, when cut in pieces, exhibit the heteromorphic formation of hydranths, as has already been observed in this hydroid.

The cœnosarc regenerates the new hydranth at the cut end by a distinct process of budding, growing out beyond the old perisarc into a knob-like projection which acquires the rudiments of tentacles in from 36 to 48 hours. This is not merely a direct transformation of the tissues of the stem into the body portion of the hydranth unaccompanied by growth, as has been described for other Tubularian hydroids, but the process is in truth a regeneration or new formation.

A piece of stem invariably regenerates a new hydranth at each end, even when lying on the bottom of a dish. Usually a foot is formed when a stem is brought in contact with a solid object, but in several cases it was found that a hydranth arose at the end which was firmly attached to the dish, the hypostome acting as the organ of attachment. This inverted hydranth did not attain to complete development, but it was a distinct hydranth provided with several short tentacles.

Only negative results were obtained from isolated tentacles, as no regeneration took place, the tentacle soon contracting into a rounded mass and dying.

Grafting may be successfully performed on the stems of Cordylophora. When freshly cut pieces are brought into contact, end to end, a firm, complete, permanent union takes place. Ectoderm unites with ectoderm, endoderm with endoderm. There is no polar differentiation in regard to the ability of the stems to fuse with each other, and in the experiments which were made, series of fused pieces were obtained representing all the possible combinations of the two poles. The united stems did not eventually break apart, but remained intact until they finally died *in toto* after several days. At the point of union between two pieces a lateral branch was given off in many cases, each portion apparently contributing equally to the branch.

A Recent Variety of the Flatfish, and its Bearing upon the Question of Discontinuous Variation. H. C. BUMPUS.

IT was shown that within the past five or six years the lower side of the flatfishes (*Pleuronectes Americanus*) from Woods Holl, Narragansett Bay and Long Island Sound has, with great frequency, become deeply pigmented over more or less definite tracts.

The abrupt appearance of a large number of individuals, varying in a definite direction, bears directly upon many current speculations of organic evolution. It was claimed that the variation being so widespread must have been the result of some environmental stimulus upon the germ, since the arrangement of the color precludes the possibility of its being the result of the direct action of light, and there is evidence to prove that the appearance of 'piebald' specimens was not due to the invasion of piebald fish from other localities.

It was also claimed that the process of natural selection could not have been materially instrumental, since the presence of the piebald specimens was first indicated by a large number of young fish, and because the time has been too brief for nat-

ural selection to eliminate either the original type or the new variety. It would, moreover, be illogical to presume that the same agent that has been instrumental in causing the disappearance of the pigment in the natural fish is the same agent, in the same locality, and under apparently the same conditions, that is instrumental in again producing pigment on the lower side.

A Precise Criterion of Species. C. B. DAVENPORT.

IN order to decide whether two allied groups are species or varieties it is necessary first to give an exact quantitative expression to the two best criteria of species —divergence and segregation—by the use of the modern mathematical method of studying individual variation. Divergence is the distance between the modes of the two groups in question expressed in units of the average deviation from the mean of the individuals of one of the groups. Segregation is inversely proportional to the number of intergrades, or it is the height of the lowest ordinate between the two modes expressed in units of the height of one of the modes.

An examination of the usage of systematists will tell us what least degree of divergence or segregation is usually expected in distinct species. Leaving the precise determination of this least degree still undecided, we may conclude: A group of allied individuals giving a dimorphic curve of a (differential) character consists of two species either when the minimum between the two groups is m [20] % or less, of the shorter mode, or when their modes diverge by n [10?] or more times the smaller average deviation of the two subgroups. Otherwise the dimorphic curve indicates two races.

Certain Results from a Study of the Variation of Littorina. H. C. BUMPUS.

THE critical study of variation in 100 specimens of Necturus revealed the fact that those individuals which were abnormal so far as location of the pelvis was concerned were also abnormal in respect to many others, and only remotely related characters; that those individuals which were unstable in respect to one character tended towards instability in respect to all characters; that variation of one organ was an indication of probable variation of other, if not of all, organs. The examination of over 1,700 sparrows' eggs encouraged the belief that this principle of the general instability of variants might be of further application, and in a recent article by Havelock Ellis, on Genius and Stature, it is concluded, on anthropological data alone, that those variations of mind which have been instrumental in producing men of eminence are accompanied by striking and remote physical variations; that those who have attained distinction as warriors, statesmen, scientists or writers have generally been above or below the mean of stature.

The speaker then exhibited 1,000 shells of *Littorina littorea* which had been arranged in order, according to their shape, from extreme elongation to extreme ventricosity, and showed that those at the extremes tended toward excessive variation in weight. Both ventricose and elongated shells were far *heavier* and *lighter* than the species of more ordinary form.

Grafting Experiments on Tadpoles, with Special Reference to the Study of the Growth and Regeneration of the Tail. R. G. HARRISON.

THE method of grafting amphibian larvæ, as described by Born in his exceedingly original and suggestive paper [Archiv f. Entwicklungsmechanik, Bd. 4], may be applied to the study of the normal growth of the embryo. Thus, when portions of larvæ of *Rana virescens* and *R. palustris* are combined in various ways to form a complete normal organism, the sharp con-

trast in color between the tissues of the two species enables one to follow in the living specimen the exact development of each part. If the tail-bud of an embryo (ca. 4.5 mm. long) of one species be replaced by a similar portion taken from the other, it may be observed that, as the tail grows, the epidermis from the body moves out over the base of the tail until about the end of the sixth day it covers its proximal two-thirds. The underlying tissues (muscle plates, notochord and spinal cord) grow apically, and the place of union between the two portions remains very near to the base of the tail, although it does shift with respect to the anus through a distance equal to about three metameres. When several segments of the body are grafted along with the tail, a similar shifting of the epidermis takes place, though less in amount, and even when the two parts are united in the region of the pronephros there is a slight backward movement. This is brought about largely, if not entirely, by the pulling of the skin due to the enormous growth of the tail as compared with the body. The parallel between the direction and amount of movement of the epidermis during development,and the mode of distribution of the cutaneous nerves in the body and tail of full-grown tadpoles, indicates that each nerve supplies that region of the integument which, at an early stage, was nearest to it.

When, in place of a tail-bud which has been removed, a similar portion of another larva is grafted by its distal end, leaving the proximal end free, a tail-like structure is regenerated. In cases where the notochords of the two parts unite, the regenerated tail attains a degree of perfection but little inferior to those regenerated from the distal end. If the notochords do not unite, regeneration may take place from both pieces, resulting in a forked tail. When neither the notochords nor spinal cords unite, the tail stump of the stock regenerates, while the grafted piece remains as an insignificant lump on the side of the tail.

In all cases (six) where virescens tails were grafted to palustris larvæ, and in fifty per cent. (four) of the cases in which palustris were grafted to virescens larvæ, degeneration of the transplanted tissue took place, beginning sometimes as early as three weeks after operation. This was independent of metamorphosis, having begun before the appearance of the extremities. The tadpoles lived for weeks afterwards with withered tails, without undergoing further metamorphosis.

One specimen in which the two parts were united in the region of the pronephros passed successfully through its metamorphosis. Little or no blending of specific characters could be observed. The head of the frog had the markings of *R. virescens*, while the body and hind legs had those of *R. palustris*.

The Structure and Development of the Excretory Organs in Limulus. W. PATTEN.

THE brick-red gland or coxal gland of *Limulus* has long been regarded as a ductless gland of uncertain significance, but we are now able to demonstrate that it is provided with a duct several millimeters in diameter and three or four inches long.

Its development has also been carefully studied, but the structure described as the developing gland proves to be the developing duct; the embryonic gland was not seen at all.

Naturally, the conclusions as to the significance of this organ based on such foundations can have but little value.

The duct in the adult is so thin-walled that it is not readily seen and is very difficult to dissect. But it may be easily injected with either celloidin or asphalt, the mass filling the duct and penetrating all through the lobes of the gland. Isolation is then effected by corrosion with caustic potash.

The duct runs straight forward along the dorso-lateral margin of the plastron, then back again, and, after many coilings, opens into a large irregular chamber, or end-sac, a remnant of the fifth coelomic cavity, situated in the middle of the posterior nephric lobe. The embryonic nephric duct develops as a tubular outgrowth of the ventral wall of this cavity. Its distal end finally unites with a short ectodermic ingrowth (readily distinguished in the adult), which opens at the base of the fifth leg.

The secretions from the four lobes of the gland are collected by gradually widening anastomosing tubules. Each lobe has many separate openings into the large tubules of the longitudinal stolon. The latter empty into the coelomic space, or end-sac, and from there a single nephric duct carries the secretions to the external opening at the base of the fifth leg.

The glandular portion of the kidney develops from six pairs of segmentally arranged 'anlagen.' Omitting all details, it may be stated that a part of the fifth coelomic cavity persists as the thin-walled chamber, or end-sac, mentioned above.

The other cavities of the thorax break down after producing, by a thickening of their neural walls, paired masses of finely granular cells. These cells become hollow and unite end to end to form irregular groups of anastomosing tubules. The longitudinal tubules of the stolon are formed in a similar manner by the union of outgrowths from each cluster of cells. Many tubes on the periphery of the gland retain this unicellular condition in the adult, but in the center of the lobes and in the longitudinal stolon the nuclei of the tubules have multiplied rapidly, giving rise to a lining endothelium of flattened cells.

The cell masses derived from the walls of the first and sixth coelomic cavities disappear. The remaining ones form the four lobes of the adult kidney.

The kidney of *Limulus* is, therefore, derived from segmentally arranged groups of excretory cells. Each group of cells probably emptied originally into its corresponding coelomic cavity, and from there to the exterior. These separate external openings have now disappeared, and the organs are united by longitudinal tubules which open by a single duct, or coelomic funnel, to the exterior.

I consider the kidney, the nephric duct and the genital duct of *Limulus* homologous, respectively, with the pronephros, the pronephric duct and the Müllerian duct of Vertebrates.

Many of the details of the above account were worked out in the biological laboratory at Dartmouth by Miss Annah P. Hazen. They will be fully described and illustrated in a joint paper that we hope will appear at an early date in the *Journal of Morphology.*

The Reaction of Amœba to Light of Different Colors and to Röntgen Rays. N. R. Harrington and Edward Leaming.

The physiological effect of Röntgen rays upon undifferentiated protoplasm is almost imperceptible as compared with the reaction produced by mechanical stimuli, heat, electricity or light.

We have found that *Amœba proteus* is extremely sensitive to changes in the color of light in which it is placed, and that it exhibits characteristic movements in different light environments.

The remarkably delicate condition of phototonus is, we think, dependent upon a favorable quality of light and an optimum temperature. Continuance in a given color produces a more or less characteristic flow; in violet a spasmodic, unsuccessful attempt to form pseudopods; in green or red a massive, diffuse bodily flow.

A quiescent *Amœba* brought from the room light into red light begins to flow in from ten to twenty-five seconds. The flow

becomes so rapid that photographs exposed one-fiftieth of a second show blurring, due to movement. On changing the red light to violet or mild white, streaming instantly stops and sometimes reverses. Swinging in green, red or yellow screens causes the flow to be resumed after an interval varying in different individuals from an almost imperceptible minimum to ten seconds. The following effect of any color was generally constant after the same preceding color, and as stimulants to flow the colors increased in effectiveness as one approached the red end of the spectrum, while as retarders of flow white light and the colors at the actinic end were most powerful.

The preceding experiments were performed by means of a large photomicrographic apparatus, the image of the *Amœba* being projected by an arc light upon the ground glass back. What little heat there was [24.8° C.] was equalized for the different colors by mica screens. Intensity was eliminated by adding more color screens, which diminished the brightness but seemed to accentuate the characteristic color effect, whether it was a retarding or a stimulating effect.

Stolonization in Autolytus varians. P. C. MENSCH.

As many as eight individual stolons have been observed in single chains of this species. The embryonic segments forming the stolons are derived as outgrowths from the last segment of the *parent stock*, which itself shows internal structures different from those of preceding segments. This process of segment formation contributes three or four segments to the future stolon, the posterior one of the series retaining its embryonic characters and forming the anal segment of the stolon. At the time the anterior of the three or four embryonic segments begin to thicken for the formation of the head a new segment appears anterior to the anal segment, and the future elongation of the stolon takes place by the separation of new segments from the anal segment.

The separation of the stolon takes place in a region of embryonic tissue which does not form part of a true segment, but which is derived from the undifferentiated tissues of the anal segment.

A wide range in the position of the chain exists in this species. In young specimens the chain is as far forward as the 19th segment of the parent stock, while in older and larger specimens it is placed as far posterior as the 59th segment, certain characters in the embryonic region of the chain indicating that, besides being active in the formation of stolons, this region also adds segments to the parent stock.

The cycle of stolonization in this species is: (1) The development of a first stolon on the young asexual individual by a process akin to fission. (2) The development of a chain of stolons from the last segment of the parent stock by budding. (3) The development of possibly a single stolon posterior to the middle region of the parent stock by true fission.

The Use of the Centrifuge for Collecting Plankton. G. W. FIELD.

HENSEN's counting method is the present basis of quantitative and qualitative Plankton determinations. Yet improvements are desirable and feasible. The desideratum is a practical, rapid, simple method capable of general application, by which data can be obtained for use in determining the comparative economic value of all waters, either for scientific agriculture or for municipal water supplies. Counting of individuals and enumeration of species seem to be necessary, together with an accurate estimation of the volume of the inorganic matter and of the organic amorphous débris.

The chemical determination of the amount

of aluminoid ammonia is practically worthless on account of the organic débris.

The main difficulty in the various methods seems to rest in the manner of collecting the Plankton. The Hensen net and its method of use are open to objections, and filtration methods vary widely in their accuracy and results. Experiments carried on at the marine laboratory of the Rhode Island Agricultural Experiment Station seem to show that the collection and determination of Plankton by a centrifuge is a very rapid and accurate method, and that the results read volumetrically on the graduated glass collector are of value when taken in connection with the nature of the material collected. The total percentage of Planktonts obtained and their condition, especially of the most delicate forms, far surpasses any other method known to me. The work has been carried on with the Plantonokrit, designed and described by Dr. C. S. Dolley (Proc. Acad. Nat. Sci., Phila., May, 1896). The machine acts upon a fixed quantity of water (2 cans, each of 1 litre capacity). Nearly two years' work with the method have given results sufficient to warrant continued experiments.

Note on Ascidian Anatomy. M. M. METCALF.

Neural gland.—A neural gland is present in all groups of Tunicates, including *Appendicularia*, *Salpidæ*, *Octacnemus*.

Its position.—In *Appendicularia*, dorsal; in *Simple Ascidians*, dorso-lateral (*Molgulidæ*), dorsal (*Cynthiidæ*) or ventral; in *Compound Ascidians*, dorsal (*Botryllidæ*) or ventral; ventral in *Doliolidæ*, *Pyrosomidæ*, *Salpidæ* and *Octacnemus*.

Its size.—Insignificant in *Appendicularia;* in *Ascidians* varies from a minute and nearly functionless gland to a size fifteen times as large as the ganglion; in *Pyrosoma* and *Salpa* small; in *Doliolum* equal to the ganglion.

Many *Simple Ascidians* have the gland prolonged into the dorsal raphe, *i. e.*, into the median portion of the pharyngeo-cloacal septum. In most of these species merely the duct of the gland is so prolonged; in other forms the raphe contains much glandular tissue in connection with the duct.

In some species of *Simple* and *Compound Ascidians* the tissue of the gland is continuous with the cellular area of the ganglion, recalling the way in which they both are formed from a common structure, the visceral region of the larval neural tube. This origin of the gland from the neural tube (as described by Julin) is readily demonstrated in *Molgula Manhattensis* and in *Ecteinascidia turbinata*.

In all species studied the secretion of the gland is formed by the degeneration and disintegration of cells proliferated from the walls of the duct or its branches. It is, therefore, extremely doubtful if the gland has any renal function. No concretions were found.

The condition of the gland is very different in different species. The divergence affects its size, position and shape. Portions present in one species may be absent in another species of the same genus. The homology of the gland in *Salpa* with that of the *Ascidians* is doubtful.

Function of ciliated funnel.—It is not merely the aperture of the duct of the gland, for (1) it is often not connected with the gland, though well developed (*e. g.*, *Salpa*), and (2) it has a rich innervation in several species of *Simple Ascidians* and apparently in some *Salpas*. In some species, at least, it is probably a sense organ.

The intersiphonal organs of Tunicates show a remarkable asymmetry. Assuming the sagittal plane of the ganglion to coincide with that of the whole animal, the funnel is on the right side, and so also is often the whole or a part of the gland.

In *Molgula Manhattensis* there is a great semilunar fold of ectoderm that pushes into the cloaca parallel to the pharyngeo-cloacal

septum, serving to support the latter and also to support the oviducts.

G. H. PARKER,
HARVARD UNIVERSITY. *Secretary.*

(*To be concluded.*)

CURRENT NOTES ON PHYSIOGRAPHY.

DRAINAGE OF SOUTHERN OHIO.

THE greater part of the Allegheny plateau and its westward slope is drained by streams of the simplest kind, dissecting horizontal strata in irregularly branching valleys. But for some years aberrant valley forms have been recognized in the upper Ohio region, special attention having been given to their meaning by W. G. Tight in his latest article on 'Some preglacial drainage features of southern Ohio' (Bull. Scient. Lab. Denison Univ., IX., 1897, 22–32). Confirmation is given to earlier views as to the composite origin of the modern Ohio. The preglacial drainage of the region led the Kanawha (via Teazes Valley), Big Sandy and other streams northward, across the present Ohio Valley, to a common trunk near Waverly. By some process not specified, the Ohio was given a course across the middle of this earlier system, deepening the older valleys for part of the distance, and elsewhere trenching across the divides at the lowest cols. The trenched cols, where the Ohio Valley is narrow and steep-walled, occur below Vanceburg, just above Portsmouth and above Guyandotte. Leverett appends a brief account of his contribution to this problem (l. c., 18–21).

THE COASTAL PLAIN OF MEXICO.

STUDIES by J. W. Spencer ('Great changes of level in Mexico and the inter-oceanic connections;' Bull. Geol. Soc. Amer., IX., 1897, 13–34) give, among other matters, an account of the coastal plain, or *tierra caliente*, that fronts the Mexican plateaus on the Gulf side. It has a breadth of fifty miles back of Vera Cruz, reaching an elevation of 1,560 feet at the inner margin, where the plateau ascends boldly thousands of feet above it. The inclined surface of the plain has not a uniform rise, but is made up of a number of steps or terraces, 50 to 100 feet high, with sloping plains between them. Streams descend from the plateau in valleys having a succession of reaches and falls; the same streams trench their way across the coastal plain. A brief account is given of the 'Geological Canal of Chivela,' on the divide of the Isthmus of Tehuantepec, 776 feet above the sea; its floor having lately been swept over the ocean currents during a depressed attitude of the region.

MOUNTAIN STRUCTURES OF PENNSYLVANIA.

THE prevalent belief in the frequent occurrence of synclinal ridges in denuded mountain ranges is discussed by A. P. Chittenden (Bull. Amer. Geogr. Soc., XXIX., 1897, 175–180), who cites the opinions of a number of authors on the matter. After showing that there is no logical reason to expect the more frequent occurrence of synclinal than of anticlinal ridges in ancient, deeply dissected mountains, the Appalachian ridges of Pennsylvania are classified and measured in three groups, monoclinal, anticlinal and synclinal; the total lengths for each group being 1,333, 334 and 245 miles. Synclinal ridges are, therefore, exceptional; the length of the monoclinal ridges far exceeding that of the other two classes. Synclinal ridges of Pottsville conglomerate in the anthracite coal regions are relatively more common than elsewhere, but even there the monoclinal ridge prevails. The synclinal valley between two neighboring monoclinal ridges often has a high-level floor, but it is surmounted and enclosed so distinctly by two ridges that the three forms cannot properly be described as a single synclinal mountain.

YOUNG, MATURE AND OLD LAND FORMS.

THE use of age-terms suggestive of sys-

tematic changes in the form of the land with the passage of time has come to be generally accepted as a means of geographical description, but not with entire agreement by all writers. One of the first illustrations of this good fashion was in an account of the driftless region of Wisconsin, in which 'topographic old age' was applied to the beautifully dissected hills of the driftless area, where an abundant and varied relief still survives. This would seem to exclude such a term as 'mature,' and to leave no appropriate term for a plain of complete denudation. In another paper the Alps are cited as 'young' mountains, denudation having there progressed 'only far enough to sculpture into very rugged relief the strata of varying hardness.' This would seem to underestimate the enormous amount of destructive work done in the Alps, and to imply that their deformation began not very long ago. Indeed, if 'young' is to be applied geographically to mountain ranges like the Alps, thoroughly dissected by adjusted valleys, some other term than 'young' would be needed for the moderately denuded Jura, or for the still less denuded lava blocks of southern Oregon. It is hardly advisable to increase the series of age terms very far, although infantile, young, youthful, adolescent, mature, decadent, senile and old have all been more or less used. Young, mature and old, with qualifying adverbs, should at any rate suffice for elementary descriptions; and in such a series both the dissected uplands of the driftless area of Wisconsin and the vigorous peaks and valleys of the Alps should be called 'mature.'

W. M. Davis.

CURRENT NOTES ON ANTHROPOLOGY.

RACIAL SOCIOLOGY OF EUROPE.

An interesting review of the researches of Lapouge and Ammon on the above subject is presented by Carlos C. Closson in the *American Journal of Sociology* for November last. The principal racial criterion, the sole one, indeed, is assumed to be the shape of the skull, and particularly of the cranial index. Dividing the area of France into the most dolichocephalic and the most brachycephalic departments, the sociological comparison shows that the dolichocephalic elements excel, not simply in the ownership of wealth, but still more in wealth-producing capacity, and most of all in commercial and financial activity. The dolichocephalic departments pay the most taxes, are more densely populated, richer and generally flourishing. They owe more money and own more bicycles. They also travel more to the cities in larger numbers.

Both Lapouge and Closson accept these results as in some way the consequences of dolichocephaly; but another view, not discussed by either, is that this form of skull is less a cause than a consequence. The studies of the late Dr. Harrison Allen on Hawaiian skulls, now in process of publication, will show that improved conditions of life profoundly modify the cranial form within the limits of the race.

THE DOOM OF THE AMERICANS.

An able and profound study of the birth rate in Massachusetts is given by Arsene Dumont in the *Journal* de la Société de Statistique de Paris, November, 1897. He shows by incontrovertible data that the marriages among the 'American born' in that State and in surrounding parts of New England reveal a steady diminution in the birth rate. This is not new. It has been emphasized by several of our own statisticians. But what is new is M. Dumont's study of its causes.

He finds its chief cause in the principle of democracy. This develops individualism, the overpowering desire of each to live his own life to the best personal advantage, to get all the good there is going, be it in the

sphere of intellect or of other gratification. But the numerical increase of the race is and must be inversely to the effort of the individual to develop himself personally. Republican civilization, he claims, contains a toxic principle. The more intense and general it becomes in a community, the more acute becomes individualism, and this will finally destroy the race and its culture. There may, however, be a democracy directed by science which can escape this poison. With this cheering but vague intimation the article closes.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

PRESIDENT MCKINLEY has, as had been feared, nominated the person from Martinsburg, W. Va., named Bowers for United States Fish Commissioner. Efforts should still be made to prevent confirmation by the Senate, but that talkative body has no time to listen, and only irrelevant accidents are likely to intervene. It is within the limits of possibility that a man chosen by lot from a penitentiary would make a better chief executive than the present 'incumbrance,' and it is quite possible that Mr. Bowers may become a competent Fish Commissioner. His record should not be prejudged and he should be given all possible assistance by men of science. No subsequent events can, however, excuse Mr. McKinley. Those having knowledge of his flabby character will not be surprised when he does a weak and foolish thing, but it is humiliating to know that the President of the United States can deliberately and with full knowledge perform an illegal act.

AT the annual public meeting of the Paris Academy of Sciences held on January 10th the numerous prizes in the gift of the Academy were awarded. Among these we may mention, in addition to the *Cuvier* prize of 1,500 francs awarded to Professor Marsh, and the *Lalande* prize of 540 francs awarded to Professor Perrine, previously announced in SCIENCE, the *Poucelet* prize of 2,000 francs awarded to M. R. Liouville for his work in mathematics and mechanics, the three *La Caze* prizes of 10,000 francs each, in physics, to Professor P. Lenard for his researches on the cathode rays, in chemistry to M. Paul Sabatier for his chemical researches, and in physiology to Professor Röntgen for his researches on the properties of X-rays and their application in therapeutics; the *Parkin* prize of 3,400 francs to Professor Augustus Waller for his researches on the effects produced by certain gases and vapors on the nerves, the *Grand prix des sciences physiques* of 3,000 francs to M. Joseph Vallot, founder of the observatory near the summit of Mt. Blanc, for his researches on the conditions of animal and vegetable life in high altitudes; and the *Petit d'Ormoy* prize to the late M. Tisserand for his researches, and especially for the *Traité de mécanique céleste*.

IT is stated in *Nature* that the Council of the Royal Astronomical Society have awarded the gold medal of the Society for this year to Mr. W. F. Denning, 'for his meteoric observations, his cometary discoveries and other astronomical work.'

IT is reported that a prize of $10,000 is offered by the Belgian government for the discovery of a chemical that will take the place of phosphorus in the manufacture of matches.

THE U. S. National Museum has recently received, by bequest, the 'I. H. Harris Collection,' composed of fossils and archæological material. Mr. Harris, a graduate of Yale in 1846, was born in Waynesville, Ohio. This village, like many other settlements in southwestern Ohio, is situated upon the Cincinnati formation, widely known for its abundant and well preserved Lower Silurian fossils. These attracted his attention about 1846, and up to his death, last October, Mr. Harris was constantly in search of new or better preserved material. The collection has more than 20,000 specimens, of which about one-third are prehistoric stone implements. Many of the latter are from the vicinity of the interesting locality, Fort Ancient, a short distance south of Waynesville. Crinoids, trilobites and starfishes are the distinguishing characteristics of this collection. Other Cincinnati group fossils are also well represented, par-

ticularly brachiopods and mollusca. This is the second large collection of fossils which has been given to the U. S. National Museum during the past five years, the other being the 'R. D. Lacoe Collection' of fossil plants.

DR. THOMAS EGLESTON, emeritus professor of mineralogy and metallurgy at Columbia University, has presented the government of France with the sum of $5,000, in aid of the mineralogical collection of the School of Mines at Paris, from which he graduated in 1860.

THE will of the late Andrew M. Moore, of Philadelphia, bequeaths his entire estate, estimated at $5,000,000, to his three sons, to be held in trust during their lifetime. On the death of the last surviving son the trustees are empowered 'to found and maintain such charitable or educational institution or establishment in my name as they desire or may deem wise or proper.' Directions are also given that the charities to be founded shall be absolutely non-sectarian.

WE learn from the *Philadelphia Medical Journal* that the Second Quinquennial Prize of one thousand dollars under the will of the late Samuel D. Gross, M. D., will be awarded on January 1, 1900. The conditions annexed by the testator are that the prize 'shall be awarded every five years to the writer of the best original essay, not exceeding one hundred and fifty printed pages octavo, in length, illustrative of some subject in Surgical Pathology or Surgical Practice, founded upon original investigations, the candidates for the prize to be American citizens.' The prize essay must subsequently be published in book form and one copy of the work deposited in the Samuel D. Gross Library of the Philadelphia Academy of Surgery. The essays, which must be written by a single author in the English language, should be sent to Dr. J. Ewing Mears, 1429 Walnut street, Philadelphia, before January 1, 1900. Each essay must be distinguished by a motto, and accompanied by a sealed envelope bearing the same motto, and containing the name and address of the writer. No envelope will be opened except that which accompanies the successful essay.

WE regret to record the death of Dr. Eduard Wiederhold, the chemist, of Cassel, on January the 11th, and of Jean Linden, the botanist, in Brussels, on January 12th, aged eighty-one years.

PROFESSOR F. B. CROCKER, of Columbia University, President of the American Institute of Electrical Engineers, has accepted the position of consulting engineer of the Electrical Exhibition to be held in Madison Garden, New York, next May.

WE learn from the *Lancet* that a meeting of the local executive committee of the British Association was held in Bristol on January 10th. It was mentioned that between £3,000 and £4,000 will be required in connection with the forthcoming meeting of the Association in Bristol, and the Mayor is sending out an appeal to the citizens for this amount. Arrangements are being made for the proposed Biological Exhibition. Several excursions have been planned, among these being visits to Bath, where the Mayor and citizens will entertain the visitors; to Aust, Tortworth, where Lord Ducie will entertain a party; to the Severn Tunnel, Stanton Drew, Cheddar, Glastonbury, Stonehenge, Salisbury, Longleat, Raglan Castle, etc. There are also committees at Montreal and Toronto (at the former city Dr. Bovey and at the latter Dr. Macallum are the Honorary Secretaries), and it is expected that a considerable number of Canadian visitors will be present at the meeting.

AT the monthly general meeting of the Zoological Society of London held on January 20th it was reported that the total number of visitors to the Society's gardens during the year 1897 had been 717,755, showing an increase of 52,751 over that of the previous year. The amount of money received at the gates during the year was £17,261, being nearly £1,600 more than the total amount received in the year 1896.

AN International Photographic Exhibition, to be held at the Crystal Palace, Sydenham, from April 27th to May 14th, is announced in the English papers. The Exhibition, which will be held under the auspices of the Royal Photographic Society, will be divided into eight sections: (1) history of photography; (2) pictorial photography; (3) portraiture and general

technical photography; (4) apparatus and material; (5) photo-mechanical processes; (6) scientific applications of photography (including medical photography and the application of the X-rays); (7) photography in color; (8) photography as a science. With such an excellent and comprehensive program in view, the success of the enterprise should be guaranteed. Further particulars can be obtained from the Secretary of the Royal Photographic Society at 12 Hanover Square, London, W.

AT the annual meeting of the Indiana Academy of Sciences, held on December 29th and 30th, the President, Professor Thomas Gray, of Rose Polytechnic Institute, delivered an address on 'The Development of Electrical Science.' A full program of 80 papers was presented. These were distributed as follows: General subjects, 9; mathematical and physical, 17; botanical, including bacteriological, 15; chemical, 8; zoological, 20; geological, 11. The following officers were elected for the year 1898: President, C. A. Waldo, Purdue University; Vice-President, C. H. Eigenmann, Indiana University; Secretaries, John S. Wright, Indianapolis; A. J. Bigney, Moore's Hill College; Geo. W. Benton, Indianapolis; Treasurer, J. T. Scovell, Terre Haute. The volume of the Proceedings of the Academy is a public document, a limited number being printed by the State. Copies are distributed under the direction of the Academy.

THE first annual meeting of the Audubon Society of the District of Columbia was held at the Columbian University, Washington, on January 31st, under the presidency of Surgeon-General George M. Sternberg.

PROFESSOR W. B. SCOTT, of Princeton University, read before the American Philosophical Society, of Philadelphia, on February 4th, a paper on 'The Exploration of Patagonia,' giving the results of the Princeton expedition of 1896–97, under the direction of Mr. J. B. Hatcher.

AT the meeting of the Council of the British Medical Association on January 19th, Dr. Dawson Williams, assistant editor of the *British Medical Journal*, who has been connected with the editorial department of the *Journal* for seventeen years, was unanimously appointed editor. At the same time Mr. C. Louis Taylor, who has been sub-editor for the last eleven years, was appointed assistant editor.

DR. H. C. WOOD, of Philadelphia, has accepted the editorship of the *American Medico-Surgical Bulletin.*

THE bill advocated by the State Medical Society regarding expert testimony was introduced in the Assembly at Albany, on January 31st, by Mr. Kelsey. According to the reports given in the daily papers the bill provides that upon the trial of all indictments for felonies, whenever it is made to appear to the Court that the trial of issues will probably require the introduction of medical expert testimony, the Court may, upon application of either party, appoint such number of experts as the Court shall deem proper, not less than three nor more than five. Such experts shall be persons skilled in medical or surgical science, or in both, and shall be duly admittted to the practice of medicine in the State of New York; but in special and extraordinary cases the Court may appoint experts living in other States. Such expert witnesses shall receive such compensation as the Court shall prescribe, which shall not be less than $10 nor more than $100 a day, while in actual attendance upon the trial, which shall be paid by the county. The expert witnesses may be examined and cross-examined in the same manner and subject to the same rules as other expert witnesses; and if, on preliminary cross-examination at the trial with reference to his qualifications, it shall appear that any such witness has, either before or after his appointment, expressed an opinion as to the merits of the action, his appointment shall be revoked and he shall receive no compensation as an expert, but he shall not, therefore, be prevented from testifying as a witness. The party applying for the appointment of expert witnesses is not to be bound by the testimony of such witnesses, but may rebut the same by counter testimony. The act is not to be construed to limit or affect the right of either party to summon other expert witnesses.

SENATOR VEST, from the Senate Committee on Public Health, has made a report on the

bill providing for the creation of a department of public health. The report is adverse to the proposition, and it recommends, as a substitute, the bill for the enlargement of the powers of the Marine Hospital service by giving the President, through this service, the right to resort to measures to prevent the spread of contagious diseases from one State to another.

Secretary Bliss has sent to the Public Land Committees of the Senate and House a bill prepared by Colonel Young, the acting Superintendent of the Yellowstone National Park, for an extension of the limits of that reservation by about 3,000 square miles.

President Skirm has introduced in the Senate of New Jersey a bill entitled 'An act to prevent the introduction into and spread of injurious insects in New Jersey, and to provide a method for compelling their destruction.' The bill has the endorsement of the State Board of Agriculture.

Professor Alfred C. Haddon contributes to the issue of *Nature* for January 20th an account of the plans for a proposed Cambridge Expedition to Torres Straits and Borneo. A committee of members of the University of Cambridge is acting in cooperation with Professor Haddon, and part of the cost of the expedition will be defrayed by a grant from the Worts' Fund, which is administered by the University. The expedition will be almost entirely anthropological in character, but the land flora and fauna will not be neglected, and certain geographical observations will also be made. Its main object is to continue and, as far as practicable, complete the earlier observations made in Torres Straits; but, for the sake of comparison, it is hoped that observations will be made on Australians, Papuans, Melanesians and Polynesians, as opportunities present themselves. After spending a few months in the Straits a short visit will be paid to the mainland of New Guinea, in order to trace the relationship of the islanders. In addition to Professor Haddon the members of the expedition are Dr. W. McDougall, Fellow of St. John's College, Cambridge, and of St. Thomas Hospital, London; Dr. C. S. Myers, Caius College, Cambridge, and St. Bartholomew's Hospital, London; Mr. S. H. Ray, Dr. W. H. R. Rivers, St. John's College, Cambridge, lecturer on experimental psychology at Cambridge and at University College, London; Dr. C. G. Seligmann, of St. Thomas's Hospital, and Mr. A. Wilkin, of King's College, Cambridge. In describing the work assigned to each member of the party Professor Haddon writes: Drs. Rivers, McDougall and Myers will initiate a new departure in practical anthropology by studying comparative experimental psychology in the field. They will test the senses and sensibility of the natives as far as it will be possible under the local conditions, and make whatever observations they can on the mental processes of the natives. Besides the ordinary instruments for anthropometry, there will be a small, carefully selected collection of apparatus for experimental psychology. Two mechanical phonographs will be taken to record the native songs, music and languages. There will also be a complete photographic equipment, including a cinematograph for reproducing native dances, ceremonies and certain characteristic actions. At the close of the article Professor Haddon expresses his willingness to make any special inquiries that any ethnologist may require. The expedition will start about March 2d, and will return early in the summer of 1899.

It is reported in the New York *Evening Post* that, at a recent meeting of the Quebec Geographical Society, Capt. Bernier explained his proposal for the discovery of the north pole. He plans to go by ship to the point north of Siberia where Nansen's vessel, the Fram, crossed the eightieth parallel of latitude. Here he intends to leave the vessel and take to the ice, with eight men, fifty dogs and fifty reindeer, carrying 36,000 pounds of provisions, for two years. He will also have sleds, kyacks and a portable boat made of aluminum and wood. By crossing the ice-floes he expects to reach the pole from the vessel in a little over a hundred days, afterwards making for Spitzbergen or Franz Josef Land. Capt. Bernier is applying to the government for assistance, and his demand will be supported by the Society, which adopted a resolution to that effect. He proposes to proceed by Bering Sea,

starting in June from Victoria, B. C.; he will reach the Siberian islands by September.

THE London *Times*, quoting the *Turkestan Gazette*, announces the arrival at Tashkent of two German professors, whose names are not given, for the purpose of fitting out a scientific expedition to Tibet and Kashgar, in which the Grand Duke of Baden has interested himself. The Russian authorities are giving every assistance, and the party will start from Osh with an escort of Cossacks.

IN commenting on the epidemic of plague in India the *Lancet* states that it has apparently gained such a hold that its proportions in the affected districts are calculated to give rise to serious alarm. The latest reports from Bombay quite bear out this view. The epidemic in that city has been greatly aggravated of late; the type of the disease is of a more virulent character than that of last year, and the mortality is reported to average more than 200 daily. It is scarcely necessary to add that trade is paralyzed, and that there is a renewed exodus of natives from Bombay. The disease also largely prevails in Poona and in the Deccan.

THE Annual Horticultural and Agricultural Exhibition at Cairo was opened on January 14th. According to the report in the London *Times* the exhibits of timber-woods showed the great capabilities of Egyptian soil and climate for their production, and the Finance Ministry is now making experiments in forestry on a considerable scale, and planting out 190,000 young trees of about 100 varieties, all exotic and chiefly from India. A novelty was seen in a substance called cerosie, of which a French local chemist claims to be the discoverer. It is extracted from the scum which rises to the surface of liquid sugar after the cane is crushed. The resulting substance is stated to possess the qualities of ordinary beeswax, which it resembles in appearance, though darker in color.

AT a recent meeting of the British Ornithologists' Club, the Chairman, Mr. P. L. Sclater, F.R.S., gave an account of ornithological journals, giving a history and description of the three principal journals—the *Journal für Ornithologie*, founded in 1853 by Dr. Jean Cabanis and becoming in 1894 the organ of the Deutsche Ornithologischen Gesellschaft; *The Ibis*, founded by the British Ornithologists' Union in 1859; and *The Auk*, established by the American Ornithologists' Union in 1884 and edited by Dr. J. A. Allen. There are, it appears, five ornithological journals in Germany, three in Great Britain, two in Austria, two in America, one in Hungary and one in Italy. There is none in France.

ACCORDING to *Industries and Iron*, the 'Crane' carried out at Portsmouth on the 26th of November her second three hours' speed trial, at which she was required to maintain a mean of 6,000 h.p. and a speed of 20 knots. The mean h.p. of the three hours was, however, 6,267, and the speed 30.347 knots. The revolutions were 397.4. During the six runs on the measured mile the h.p. gave a mean of 6,480, the speed being 30.724 knots, and the revolutions 404½. The mean air pressure for the entire run was 3 in. At the first three hours' trial the coal consumption, which was required not to exceed 2½ lb. per unit of power per hour, has been ascertained to have been 2.4 lb.

A PROPOSAL was made some time ago for the introduction of the seeds of certain trees from India and Ceylon into British Central Africa for the purpose of supplying shade for the coffee plants in the numerous plantations which are now being opened up in the protectorate. The Foreign Office, says the London *Times*, requested Mr. Thiselton-Dyer, the Director of Kew Gardens, to report on the subject. As a result of Mr. Thiselton-Dyer's reports, her Majesty's Commissioner has determined to rigidly enforce the regulations for the prevention of coffee disease in Central Africa, which prohibit the importation of seeds from India and Ceylon. In his report Mr. Thiselton-Dyer says: "The coffee disease was introduced into Fiji through the instrumentality of tea seeds from Ceylon. Notwithstanding the splendid attempts of Sir William MacGregor to stamp it out, it ultimately completely destroyed the coffee industry, which was the most promising planting enterprise in the colony. The Germans, by some unknown means, have succeeded in introducing the disease into their African territories. In the face of these undoubted facts, it would, in my

opinion, be the height of folly to run the smallest risk of introducing the disease into British Central Africa, where its presence would be an irreparable disaster. Knowing the mechanical way in which such work is carried out by native officials in India, I do not think that any stipulation as to locality is of the smallest value. Whatever was stated to the contrary, the first parcel of seed would, in all probability, come from a plantation reeking with disease. The present request is the more unnecessary as, according to a coffee planter in Nyassaland who is well acquainted with coffee cultivation in Ceylon, a local African tree, *Albizza fastigiata*, is admirably adapted for a shade tree for coffee. If this is not sufficient, the rain tree, *Pithecolobium saman*, might be tried. The seed can be obtained in abundance from Jamaica, and this would be perfectly safe."

MESSRS. G. P. PUTNAM'S SONS will begin early in the present year the publication of a new series of scientific books, 'The Science Series,' edited by Professor J. McKeen Cattell, Columbia University, with the cooperation of Frank Evers Beddard, Esq., F. R. S., in Great Britain. It is expected that the following will be among the earlier volumes to be in readiness:

The Stars. By PROFESSOR SIMON NEWCOMB, U. S. N., Nautical Almanac Office and Johns Hopkins University.

The Earth as a Planet. By PROFESSOR C. A. YOUNG, Princeton University.

The Measurement of the Earth. By PRESIDENT T. C. MENDENHALL, Worcester Polytechnic Institute, formerly Superintendent of the U. S. Coast and Geodetic Survey.

Earth Structure. By PROFESSOR JAMES GEIKIE, F.R.S., University of Edinburgh.

Volcanoes. By PROFESSOR T. G. BONNEY, F.R.S., University College, London.

Earthquakes. By MAJOR C. E. DUTTON, U. S. A.

Physiography: The Forms of the Land. By PROFESSOR W. M. DAVIS, Harvard University.

The Groundwork of Science. By DR. ST. GEORGE MIVART, F. R. S., Chilworth, Surrey.

The History of Science. By C. S. PIERCE, Milford, Pa.

The Study of Man. By PROFESSOR A. C. HADDON, Royal College of Science, Dublin.

General Ethnography. By PROFESSOR DANIEL G. BRINTON, University of Pennsylvania.

Recent Theories of Evolution. By J. MARK BALDWIN, Princeton University.

The Animal Ovum. By F. E. BEDDARD, F. R. S., Zoological Society, London.

The Reproduction of Living Things. By PROFESSOR MARCUS HARTOG, Queen's College, Cork.

The Structure of Man. By A. KEITH.

Heredity. By J. ARTHUR THOMSON, School of Medicine, Edinburgh.

Life Areas of North America: A Study in the Distribution of Animals and Plants. By DR. C. HART MERRIAM, Chief of the Biological Survey, U. S. Department of Agriculture.

Age, Growth, Sex and Death. By PROFESSOR CHARLES S. MINOT, Harvard Medical School.

UNIVERSITY AND EDUCATIONAL NEWS.

THE sum of $50,000, necessary to secure a gift of $10,000 from the Baptist Educational Society of America, has been raised by subscription for Colby University. It is stated that this money will be in part used for the erection of a chemical laboratory.

THE attempt to break the will of William Sauser, of Hannibal, Mo., who died in 1892 and bequeathed all his property, valued at $200,000, to Westminster College, Hannibal, Mo., a Presbyterian institution, has failed.

THE Town Council of Aberdeen has voted £5,000 to the University buildings extension scheme, on condition that the same be completed.

AT the meeting of the Edinburgh University Court on January 17th intimation was made of a donation of £1,000 by Sir William Overend Priestley, M.P., for the Universities of St. Andrews and Edinburgh. The very Rev. Dr. William Charles Lake, late Dean of Durham, has bequeathed £1,000 to the Durham College of Science, at Newcastle-on-Tyne.

THE Geological Laboratory of King's College, London, has received a valuable gift of minerals and recent shells from Miss A. Mallet in aid of the equipment for teaching purposes in the faculty of natural science and engineering.

AT the first meeting of the governors of Mason University College, Birmingham, which has recently been incorporated, the President of the College (the Right Hon. J. Chamberlain, M. P.) made an important speech on the subject of a Midland University.

DR. FRANK M. MCMURRY, Dean of the

School of Pedagogy of the University of Buffalo, has been appointed professor of the theory and practice of teaching at the Teachers' College, New York. The study of education and the professional training of teachers will be abandoned at Buffalo at the end of the present year, special measures having been taken to enable the students of Professor McMurry to continue their work under him at Columbia University. Dr. W. B. Elkin, lecturer in philosophy at Cornell University, has been appointed to an instructorship in the theory and practice of teaching.

MR. H. BAGNALL POULTON, M.A., F.R.S., Hope professor of zoology at Oxford University, has been elected to a Fellowship in Jesus College, under the statute providing for the election of 'any person of eminence in literature, science or art whose presence on the governing body would, in the judgment of the Principal and Fellows, be beneficial to the college.

MR. FRANK CLOWES has accepted the position of chief chemist to the London County Council, and has been made emeritus professor of chemistry of University College, Nottingham.

M. LE CHATELIER has been appointed to the chair of mineralogical chemistry in the College de France, vacant by the death of M. Schützenberger, and Professor G. M. Searle has been appointed Director of the Vatican Observatory at Rome in the place of Father Denza. Dr. Straubel has been promoted to an assistant professorship of physics at the University of Jena, and Dr. Brendel, docent in astronomy, to an assistant professorship in the University of Greifswald.

DISCUSSION AND CORRESPONDENCE.

A NOTE ON THE SOUTH AMERICAN COASTAL CLOUD.

TO THE EDITOR OF SCIENCE: The following brief notes on the coastal cloud of the west coast of South America may be considered as supplementary to the notes on clouds printed in SCIENCE for August 27th last.

One of the most interesting features in the meteorology of the desert region which extends roughly from lat. 3° S. to 30° S., along the west coast of South America, is the almost constant presence of a bank of clouds over the coast range of hills and the strip of land immediately adjacent to the ocean. On the writer's voyage up this coast from Valparaiso to Panama, accomplished at intervals during the months from August to January, it was noted that the southern limit of this coastal cloud coincides very nearly with the southern limit of the rainless belt, and that its northern limit may be taken as defined by the latitude at which the zone of heavy rainfall in Ecuador begins and the desert strip ends.

The height of the base of the cloud, which seemed usually to be a low *strato-cumulus*, was determined in a few cases by means of aneroid barometers and found to be between 2,000 and 3,000 feet above sea-level. The vertical thickness of the cloud was found, by reference to the heights of the coast range of hills, to be less than 1,000 feet. As to the width of the cloud, from its seaward to its landward side, a few crossings by railroad from the ocean to the interior country showed an inland extension of roughly between ten and twenty miles. This distance probably depends partly upon the trend of the coast range of hills and partly upon the topography of the region. The extension of the coastal cloud to seaward apparently also varies considerably. Sometimes the shore-line itself was found to mark the limits of the cloud as sharply as if they were drawn with a ruler, and at other times the cloud was noticed extending as far as ten or even fifteen miles off shore.

A study of the growth of the cloud, and of its relations to the clear sky on the seaward and landward sides, would be very interesting. For instance, on December 16th, last, at 8 a. m., when the writer was in Mollendo, there was a very sharp dividing line between the low gray coastal cloud over the land and the blue sky, with a few *cirro-cumulus* clouds dotted over it, over the ocean. Later in the morning the coastal cloud extended itself seaward and the sharp line of division was lost. The contrast between the region along the coast covered by this cloud belt and the country inland, beyond the reach of the cloud, is usually very striking. But it is interesting to note that, if a sufficient

distance from the sea and a sufficient altitude are reached, another region of cloud is encountered, so that there are two cloudy zones, separated by a zone over which the sky is prevailingly clear. This contrast was well seen by the writer at the beginning of the cloudy season in December, on trips between Mollendo, on the coast, and Arequipa, 80 miles inland in a direct line, 7,550 feet above sea-level. The same three zones were passed through on a trip up the Oroya Railway, from Callao, at sea-level, to Oroya, 12,178 feet above the sea.

As to the cause of the coastal cloud, that would seem to be found in the prevalence of cool southerly and southwesterly winds—the spiral outflow on the eastern side of the South Pacific anticyclone—blowing along shore or obliquely on shore along the whole desert strip of the Pacific coast of South America. These northward blowing and hence warming winds flow from a cool ocean surface on to a warmer land. They, therefore, becoming warmed, are increasing their capacity for water vapor, and instead of being rain-bearing, as might be expected in the case of on-shore winds which are forced to ascend by the topographic conditions, they are hostile to the production of rain. It is true, to be sure, that the adiabatic cooling due to their enforced ascent over the low coastal hills is sufficient to produce cloudiness, but it does not seem sufficient, in most cases, to produce precipitation. North of Paita, where the cold ocean current and the southerly winds turn off to the westward, the barren strip comes to a sudden end, and the coastal cloud, so far as could be determined by the observations of only one voyage, comes to an end also.

That the range of hills along the coast plays an important part in the production of the coastal cloud was shown by the fact that where the immediate seacoast is low, as, *e. g.*, at and for a short distance north of Pisco, there the coastal cloud was absent.

R. DeC. Ward.

Colon, Colombia, January 12, 1898.

NEWCOMB'S PHILOSOPHY OF HYPER-SPACE.

There is in Professor Newcomb's beautiful address (Science, January 7, 1898) a marked naïveté. He says: "Certain fundamental axioms are derived from experience, not alone individual experience, perhaps, but the experience of the race." On the contrary, the hereditary geometry, the Euclidean, is underivable from real experience alone and cannot be even proved by experience. Its adequacy as a subjective form for experience has not yet been disproved, but might in future be disproved. It can never be proved.

The realities which with the aid of our subjective space form we understand under motion and position, may, with the coming of more accurate experience, refuse to fit in that form. Our mathematical reason may decide that they would be fitted better by a non-Euclidean space form. But we are, and shall be, helpless to get such a space form from any experience whatever.

Space is presupposed in all human notions of motion or position. We may drop out such specifications from our space form as render it specifically Euclidean, but we cannot replace them by non-Euclidean. Euclidean space is a creation of that part of mind which has worked and works yet unconsciously.

It is not the shape of the straight lines which makes the angle-sum of a rectilineal triangle a straight angle. With straight lines of precisely such shape, but in a non-Euclidean space, this sum may be greater or less. In non-Euclidean spaces, if one edge of a flat ruler is a straight line the other edge is a curve, if the ruler be everywhere equally broad. In any sense in which it can be properly said that we live in space, it is probable that we really live in such a space. What becomes of the dogma that fundamental axioms are derived from experience alone?

George Bruce Halsted.

Austin, Texas.

SCIENTIFIC LITERATURE.

Traité des variations du système musculaire de l'homme, et leur signification au point de vue de l'anthropologie zoologique. Par Le Dr. A.-F. Le Double, Professeur de l'anatomie a l'École de Médecine de Tours, avec une préface de M. E.-J. Marey. En deux volumes. Paris, Schleicher Frères. 1897.

During the last twenty years large numbers of scattered observations on muscular anoma-

lies have been published, together with attempts at explanation of their significance, which for the most part have left a good deal to be desired. Testut's work on this subject, published in 1884, has been the only at all systematic account. The present one, however, supersedes it, both from its greater scope and from its more philosophic spirit. The work of analyzing the variations of each muscle, of grouping together the observations of others and discussing the comparative anatomy, has been most thoroughly done, so that the book is indispensable to all workers in this branch of anatomy.

At the end of the second volume are the general considerations, treating among other things of the classification and significance of anomalies. We should say, in the first place, that, though Le Double occasionally uses the word *anomaly*, he has chosen *variation* as the correct one, holding that the former implies a knowledge of all the laws and of the fixity of species, which last he evidently does not believe in. He rejects unity of plan as any explanation, though he quotes a really eloquent passage from Geoffroy Saint-Hilaire in support of it. On the other hand, he is not only more conservative, but more philosophic than those who would call all anomalies atavistic. As Poirier has written: "Lorsqu'un auteur, pour expliquer le muscle présternnal de l'homme, remonte ou descend jusqu'au serpent, il court grand risque de n'être pas suivi." Le Double points out that in this respect Macalister has done him an injustice by classing him among those of this set.

His system divides variations into three classes: First, regressive, reversive, atavistic and theromorphic; second, progressive ones; third, monstrosities. The last word is not used in quite the ordinary sense, but rather to include such muscles as cannot be made to fit into the other classes. He believes that their number will steadily diminish with the progress of the departments of science bearing on the question.

It is very hard to find two men in accord on the significance of anomalies, but at least the day of those who would call everything atavism and resent criticism is on the wane. On the other hand, a satisfactory explanation of many points is wanting. Without quite agreeing with Dr. Le Double, we wish to call attention to an excellent piece of work that is a true contribution to the facts of anatomy.

THOMAS DWIGHT.

The New Psychology. By E. W. SCRIPTURE. London, Walter Scott; New York, Charles Scribner's Sons. 1897. (Contemporary Science Series.) Pp. xxiv+500. Price, $1.25.

Dr. Scripture here gives us an account of the work which has been carried on in the psychological laboratories. After a general treatment of the methods, he presents, under various heads, the technique and results of a wide range of experiments, and has helped out the narrative by a plentiful use of illustrations. There is also an historical sketch of the rise of experimental research in psychology, together with a chapter on the present state of the work in various lands, to which Professor Binet has contributed some interesting pages on past and present conditions in France. Binet is evidently pleased that the study of hysteria and hypnotism is yielding to an interest in 'aphasia, arithmetical prodigies, memory, the superior intellectual functions, and also the organic and motor functions connected with intellectual states.' He believes 'that French psychology will long continue in this path, on which he entered about 1890.' The book closes with an appendix containing a number of mathematical tables and formulæ.

In the general grouping of experiments Dr. Scripture has taken new and, on the whole doubtful ground. He has attempted to make psychology speak the language of physics by dividing experiments into those involving Time, Energy and Space. The division entitled 'Energy' is the rag-bag into which everything is thrown that doesn't readily fall under 'Time' or 'Space.' The scheme is an awkward one, and if it gives some borrowed feeling of scientific exactness it can only be at the expense of clear thinking in the purely psychological field. Classification is, at best, a thankless task; but since it has to be done it would seem best to group experiments more according to the mental process we are really investigating than according to the object on which this process plays. For instance, from a psychological stand-

point there is a deeper kinship between an experiment on the discrimination of space-intervals and one on the discrimination of time-intervals than there is between the latter and experiments in simple reaction-time. And yet in the author's arrangement the mere difference in the object separates the various experiments on discrimination by nearly the thickness of the book, while the time elements bring reaction experiments close to those on the estimate of time-intervals, although the mental processes investigated in these experiments are as different as can be.

But it is when interpreting experimental results that the author shows to least advantage. If one were to generalize on the character of the new movement in psychology from such writings as this, one might say that the 'New Psychology' is wofully lacking in psychological insight. There is tireless nicety in gathering 'facts,' only to make slovenly generalizations which these facts do not warrant. Emerson could have pointed to this as another illustration of his wide law of compensation. If the older psychology was deficient on the side of exact experiment, the new seems too often wanting in any clear notion of what the experiments prove.

Many illustrations of this could be gathered from the book, but the single instance of tap-time must suffice. The rapidity with which taps can be given on an electric key is assumed by the author to indicate the rate at which we can make separate acts of will. In truly scientific work, however, it would seem appropriate that the same exactness which is displayed in recording and counting the taps should also be used in determining whether these separate movements of the finger are really due to separate acts of will. To the present writer, at least, the maximum rate of tapping seems to be obtained by a peculiar muscular tension which is preserved (it is true) by an act of will, but the separate oscillations of the finger are no more indicative of distinct acts of will than a sustained rigidity would imply a separate volition for each unit of time the contraction was maintained. Let us, by all means, have the spark-method and full tables of mean variation and all else that scientific accuracy may require, but let us not neglect the weightier matters of the law.

But, in spite of these and other defects, the volume gives a really valuable account of the more mechanical side of the experimental work, and contains in small compass much that had never been gathered into any single book. So that Dr. Scripture has done good service in collecting and arranging all this material. It is to be regretted that the author's unfortunate manner will, in too many cases, prevent even his account of laboratory contrivances, in which he is at his best, from getting the hearty recognition which the reader would otherwise be sure to give.

G. M. STRATTON.
UNIVERSITY OF CALIFORNIA.

Traité élémentaire de mécanique chimique, fondée sur la Thermodynamique. By P. DUHEM. Paris, A. Hermann. 1898. Vol. II. Large 8vo. Pp. 378. Price, paper, 12 fr.

In treating the subject of chemical equilibrium one can classify the matter according to components and subdivide according to variance, or one can reverse this, classifying according to variance and subdividing according to components. The first method is well adapted to books on qualitative equilibrium, in which the object is to get a clear view of the behavior of a system as a whole. In books on quantitative equilibrium it seems more rational to group like equations together, and for that reason it is better to discuss all nonvariant systems and then all monovariant systems. Since this second method has not yet been adopted by any one, it is perhaps not surprising to find that Duhem has chosen the other in preference. The present volume, the second of the series, treats of the laws describing one-component systems and the systems which can be made from these by addition or subtraction of heat or work. This last statement may not be clear without some explanatory comment. If we start with solid ammonium chlorid we certainly have a one-component system, and this is not altered by the fact that the vapor given off by this substance is composed chiefly of ammonia and hydrochloric acid. If we are not to make any distinction between a substance which dissociates in the vapor phase and one

which does not, there is no question but that we should take up next the case of a substance which dissociates into a vapor and a liquid or a vapor and a solid. An instance of this last is calcium carbonate, which dissociates on heating, forming carbonic acid and calcium oxide. This is a two-component system, but it has been derived from a one-component system by heating, and is therefore discussed by Duhem. This is a very ingenious way of attacking the subject, and has the great merit that the transition from one to two components is made gradually and not abruptly. It has the disadvantage that one has to cover this intermediate ground a second time when studying two-component systems. What Duhem has done is to consider, in this volume, systems such that the sum total of all the masses in all the phases can be represented by the chemical formula for a compound.

The book is divided into three parts, the first of which includes saturated vapors, the phenomena of boiling, change of freezing point and equilibrium between solid and solid, dissociation curve for two solids and vapor, the triple point and the curves meeting in it. The second part of the volume deals with the continuity between the liquid and the gaseous states, while dissociation in the vapor phase is taken up in the closing section. Of special interest are the chapters on the phenomena of boiling, on apparent false equilibrium as applied to boundary curves, on dissociation in gases and on the theory of false equilibrium. The book attempts, in an admirable manner, to present exact theory in such a form as to be applicable to experimental data and not to hypothetical or simplified phenomena. Of course, this is a goal which no treatise can hope to attain at the present time; but this volume of Duhem's comes nearer to it than anything that has yet been published. It is not too much to predict that the whole study of organic chemistry will be revolutionized as soon as the points of view suggested by Duhem become well understood. All the phenomena connected with isomerism become capable of quantitative treatment as soon as they are studied experimentally with reference to the theory of false equilibrium and the theory of permanent changes recently developed by Duhem. It seems probable that it will be possible, by application of these same two theories, to make an intelligent study of all chemical reactions not involving more than four components.

WILDER D. BANCROFT.

SOCIETIES AND ACADEMIES.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 478th meeting of the Society was held at the Cosmos Club at 8 p. m., on January 22d. Two papers were presented: The first by Dr. Walter Hough on the 'Origin and Range of the Eskimo Lamps.' The conclusions reached were: That the Eskimo before he migrated from his pristine home had the lamp, this utensil being a prerequisite to migration into high latitudes. That one of the most important functions of the lamp is for melting snow and ice for drinking water. That the lamp is employed for lighting, warming, cooking, melting snow, drying clothes and in the arts, thus combining in itself several functions which have been differentiated among civilized peoples. That the architecture of the house is related to the use of the lamp. The house is made non-conducting and low in order to utilize the heated air. That the lamp is a social factor, peculiarly the sign of the family unit, each head of the family (the woman) having her lamp. That the invention of the lamp took place on some seacoast, where fat of aquatic mammals of high fuel value was abundant, rather than in the interior, where the fat of land animals is of low fuel value. That the typical form of the lamps arises from an attempt to devise a vessel with a straight wick edge combined with a reservoir giving the vessel an obovate or ellipsoidal shape.

Finally, from observation of lamps from numerous localities around the Eskimo shoreline, it is concluded that lamps in low latitudes below the circle of illumination are less specialized than those of higher latitudes. For instance, the lamps of southern Alaska have a wick edge of two inches, while those of Point Barrow and northern Greenland have a wick edge of from 17 to 36 inches in width. It becomes possible, then, to say with some certainty the degree of north latitude to which a lamp appertains, light and temperature being

modifying causes. Driftwood, the fuel supply, and the presence or absence of materials from which to construct the lamp must also be considered. The cause of the large lamps coming down so far in latitude on the east is on account of the dipping of the isotherms. The lamps of Labrador are a case in point. There are three kinds of Eskimo lamps—the house lamp, the small lamp for temporary use by hunters and travellers, and the mortuary lamp.

The second paper, by Mr. René de Saussure, on 'A New Method of Plotting Maps and Charts,' was omitted on account of the author's inability to be present.

The third paper, by Professor J. H. Gore, was entitled 'Gheel, a Colony of the Insane.' This last paper was both highly interesting and instructive, but no abstract of it is available at the present moment. E. D. Preston, *Secretary.*

GEOLOGICAL SOCIETY OF WASHINGTON.

At the regular meeting of January 26, 1898, one of the principal communications was on the Montreal meeting of the Geological Society of America, by Mr. David White and Mr. Whitman Cross, both of the United States Geological Survey, a subject which has already been fully reported in these columns. There was also some discussion of the paper that was read by Mr. Cross at the preceding meeting.

Mr. G. K. Gilbert, United States Geological Survey, gave a description of the Pueblo (Colo.) folio of the Atlas of the United States, a folio just completed. The ground that he went over is fully covered in the printed descriptions to accompany the folio. W. F. Morsell.

U. S. Geological Survey.

THE ENGELMANN BOTANICAL CLUB.

The club met at the Shaw School of Botany, St. Louis, on January 13th, thirty-four members present. The following officers for 1898 were elected: President, William Trelease; Vice-Presidents, Geo. W. Letterman, Henry Eggert; Secretary, Hermann von Schrenk.

Professor L. H. Pammel briefly discussed the flora of Iowa, giving an account of the topography and climatology, and their bearing on the distribution of plants in that State. He spoke of a series of ponds which had dried to such an extent that the collected humus burned when lighted. These ponds had been flooded last year and a surprisingly large number of aquatic plants had apparently survived the drying process.

Mr. J. B. S. Norton spoke on the coloring matter of some Borraginaceæ. He described some specimens of *Plagiabothrys Arizonica*, which stained paper a violet-purple, and attributed this to alkanin. The occurrence of this dye in other North American Borraginaceæ was discussed.

Mr. H. von Schrenk presented some notes on the dry-rot fungus, *Merulius lacrymans*, which had been found in the beams of a building in which the floors had fallen in. He exhibited specimens of the fungus collected in fallen cypress logs in northwestern Mississippi. Some other fungi collected in that region were discussed. Hermann von Schrenk, *Secretary.*

NEW BOOKS.

The Sun's Place in Nature. Norman Lockyer. New York and London, The Macmillan Co. 1897. Pp. xvi+360. 12s.

Various Fragments. Herbert Spencer. New York, D. Appleton & Co. 1898. Pp. 208. $1.25.

The Mystery and Romance of Alchemy and Pharmacy. C. J. S. Thompson. London, The Scientific Press, Ltd. 1897. Pp. xv+335.

The Barometrical Determination of Heights. F. J. B. Cordiro. New York and London, Spon & Chamberlain. 1898. Pp. 28. $1.00.

Traité de zoologie concrète. Yves Délage and Edgard Hérouard. Volume V. *Les vermidiens.* Paris, Schleicher Frères. 1897. Pp. xi+372.

Le Rationnel. Gaston Milhaud. Paris, Alcan. 1898. Pp. 179. 2 fr. 50.

Energetische Epigenesis und epigenetische Energieformen. George Hirth. Munich and Leipzig, G. Hirth. 1898. Pp. xiv+218.

Outlines of Sociology. Lester F. Ward. New York and London, The Macmillan Company. 1898. Pp. xiii+301. $2.00.

SCIENCE

FRIDAY, FEBRUARY 18, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE ITHACA MEETING OF THE AMERICAN PHYSIOLOGICAL SOCIETY.

THE tenth annual meeting of the American Physiological Society was held at Cornell University, December 28 and 29, 1897. Owing to a variety of reasons, but largely to the facts that since the last annual meeting the Society held in May a very successful special meeting in Washington in conjunction with the Fourth Medical Congress, and that its members took an active part in the proceedings of the Toronto meeting of the British Association for the Advancement of Science and the Montreal meeting of the British Medical Association, the attendance at Ithaca was not so large as usual. An enjoyable 'smoker' was held on the Monday evening preceding the meetings, at which the members of the Society received many of their friends from the other Affiliated Societies. Formal sessions for the presentation of papers and the transaction of business were held on Tuesday and Wednesday forenoons; Tuesday afternoon was devoted to demonstrations; and on Wednesday afternoon the Society took part in the joint meeting of the Affiliated Societies.

A matter of unusual interest was the presentation of the report of the committee on publication of the proposed physiological journal. This committee consists of Professor Bowditch (Harvard), Chittenden (Yale), chairman,

Howell (Johns Hopkins), Lee (Columbia), Loeb (Chicago), Lombard (Michigan) and Porter (Harvard), and its report consisted of an account of its labors during the preceding six months. These labors culminated in the establishment of a new journal, *The American Journal of Physiology*, the first number of which was presented to the Society. This publication is the outcome of a feeling of the need of ready means of publication, long held by American physiologists. It will be issued under the auspices of the Society, with about one volume a year, and with the above committee as the board of editors. It will be devoted solely to the publication of the results of original researches in physiology and allied sciences, and is issued in an unusually attractive and serviceable form, with Ginn & Company as publishers. The Society passed a vote of thanks to the committee, and especially to Professor Porter for his zealous labor in behalf of the new publication.

A communication from Drs. John W. Graham and H. Sewall, of the local committee for the Denver meeting of the American Medical Association, was presented, inviting the Society to attend the coming meeting of the Association in June. Professor Sherrington (Liverpool), on behalf of the British physiologists, sent a cordial invitation to the Society to take part in the proceedings of the International Physiological Congress in Cambridge, England, in August, 1898.

One year ago, at the suggestion of Dr. S. Weir Mitchell, a commission was organized by the Society to investigate the physiological properties of the edible and poisonous fungi. This commission now consists of Professors Chittenden (Yale), chairman, Abel (Johns Hopkins), Pfaff (Harvard) and Bowditch (Harvard). During the past year it has inaugurated work in several laboratories, and the results of this work were in part presented at Ithaca. Professor L. B. Mendel (Yale) reported his researches upon the composition and nutritive value of some edible American mushrooms. Chemical analyses were combined with experiments in artificial digestion, and special attention was given to the amount of available (digestible) proteid present. The latter was found to be not over two or three per cent. in fresh mushrooms, which shows that the prevailing idea of the great nutritive value of mushrooms is not yet justified. They may be valuable as dietetic accessories, but they do not deserve the term 'vegetable beefsteak.' Their nitrogen is largely in the form of non-proteid bodies. The amount of fat, cholesterin, soluble carbohydrates, crude fiber and inorganic substances contained in them corresponds in general with that found in other vegetable foods, such as peas, corn and potatoes. Professor Chittenden reported the results of some preliminary experiments upon the toxicity of some species of poisonous mushrooms, made by Dr. W. S. Carter (University of Texas). In view of the great interest now shown in the edibility of mushrooms, the investigations of the commission, which are being actively continued, will prove of immediate practical value.

A number of papers on physiological chemistry from the Yale laboratories were presented. Professor Chittenden gave the results of a study of the variations in the amylolytic power of the human saliva and their relation to the chemical composition of the secretion. Saliva collected before breakfast is stronger in amylolytic power than that secreted after breakfast. Similarly, the alkalinity of the former (due to alkaline phosphates and indicated by lacmoid) and its acidity (due to acid phosphates and indicated by phenolphthalein) are greater than the same properties in saliva collected after breakfast. The greater amylolytic power is due not to the greater

alkalinity, but to the greater concentration of the secretion coming from glands that have been resting. Stimulation of the mucous membrane of the mouth-cavity by the vapor of ether or chloroform, or by alcohol, whiskey or gin causes a secretion richer in digestive power and solid matters than that caused by mechanical stimulation. Professor Lusk presented experimental evidence for the view that in acute fatty degeneration the dextrose that is formed from proteid in the cell is converted into fat. Professor Mendel reported preliminary experiments on the quantitative variations in the excretion of kynurenic acid.

Upon invitation Professor W. Hallock (Columbia) gave an account of his researches with Dr. F. S. Muckey on the action of the larynx in the production of voice. The larynx is essentially a string-, not a reed-instrument. In the correct mode of voice-production, pitch is controlled by the intrinsic laryngeal muscles, and registers should be absent. Registers result from the action of the extrinsic muscles interfering with the proper action of the intrinsic muscles and causing a distortion of the larynx. The authors have analyzed tones by photographing the movements of sensitive flames, and have verified in general the conclusions of Helmholtz and König regarding quality. The chest, antra and sinuses do not act as resonance-chambers to reenforce the tone.

Dr. S. J. Meltzer (New York) demonstrated a new method of anæsthetizing animals by ether administered through the rectum ; a new pleural cannula *in situ ;* and a simple method for the redistension of the collapsed lung. Professor Porter (Harvard) demonstrated, for Mr. F. H. Pratt, the isolation of the heart of the cat and its nutrition. A short glass tube was tied into the right ventricle of the excised heart. When a little defibrinated blood was poured in, contractions proceeded as normally.

Professor W. Patten (Dartmouth) outlined a new theory of color vision, based on the structure of the retinal cells in invertebrates. According to his observations, the structures in the eyes of invertebrates corresponding to the rods and cones of vertebrates are generally composed of groups of simple or compound wedges, containing a system of transverse fibrils accurately graded in length, according to their position in the wedges. The fibrils are always arranged in planes at right angles to the rays of light. All the fibrils in these planes may be parallel to one another, or at varying angles, or they may radiate from the axis of each rod, like the bristles in a test-tube cleaner, so that no two fibrils in the same plane are parallel. By assuming that the length and angular relations of a fibril determine the amount of its response to a wave of light of a given length and plane of vibration, it is possible to offer a logical explanation of many phenomena of color vision.

Professor G. P. Clark (Syracuse) gave an account of work that he had recently carried on with Professor von Frey, of Leipsic, upon certain characteristics of the pressure-sensations of the human skin. This dealt especially with the relations between the sensations caused by pressure and those caused by pull or traction. It was found, among other things, that the points most sensitive to pressure are also most sensitive to traction, that fatigue for the former stimulus is fatigue for the latter, and that the strength of the stimulus, the rate of application, the size of the surface and the locality of the skin to which the stimulus was applied, bear the same relation to the effectiveness of the two kinds of stimuli. The inference is that the two are mediated by the same sense-organs.

Professor Porter (Harvard), in behalf of Professor Bowditch, reported further observations by Mr. W. B. Cannon, upon the

movements of the œsophagus and stomach. The ingenious method, mixing food with subnitrate of bismuth and observing the process of swallowing and the movements of the stomach by means of the X-rays and the fluoroscope, had been announced previously. The details of the movements were described.

Professor Porter, who has been engaged for several years upon an experimental study of the mammalian heart, presented the results of his latest work. Among other things he described an ingenious method which he had devised for the study of the currents of blood in the root of the aorta. A small cylinder, made of hen's feather covered with lead foil, is fastened by a very short silk tether to the end of a probe, which is passed through the carotid artery and aorta down to the semi-lunar valves. The cylinder is so constructed as to have the same specific gravity as the blood. Its movements accordingly do not differ from those of an equal mass of blood. The lead foil makes the cylinder opaque to the Röntgen rays, so that its movements may be seen with the fluoroscope after the removal of the ribs. Thus the direction of the currents of the blood in the aorta is made visible.

Mr. F. W. Barrows discussed the results of his experimental studies on the effect of inanition on the structure of nerve-cells. In famished rats a decided shrinkage in the size of the cells and the nuclei was observed, and a still greater shrinkage in the nucleoli. The cells stain faintly with osmic acid, and the protoplasm shows a fine vacuolation. The general effects are similar to those produced by intense activity.

A number of papers were read by title in the enforced absence of their authors. At the joint session of the Affiliated Societies, Professor J. Loeb (Chicago) represented the physiologists in a paper entitled 'The Physiological Problems of To-Day.' This has already been published in SCIENCE, p. 154.

A revised constitution was adopted by the Society. The project for a catalogue of physiological literature by the Concilium Bibliographicum of Zürich was presented by Professor Porter. The cordial thanks of the Society were extended to the authorities of Cornell University for the many courtesies shown during the meeting.

FREDERIC S. LEE,
Secretary.

COLUMBIA UNIVERSITY.

AMERICAN MORPHOLOGICAL SOCIETY (II.).

Preliminary Notice of a New Species of Endoproct — Loxosoma Davenportii — from the Massachusetts Coast. W. S. NICKERSON. (Read by title only.)

THE specimens upon which this notice is based were found in Cotuit Harbor, Mass., and, as they differ in several important respects from any species hitherto found, it is proposed to describe them under the name *Loxosoma Davenportii.* The specimens were about two millimeters long. Each had a cylindrical stalk or foot, which passed without abrupt transition into a slightly expanded body containing a U-shaped digestive tube, etc. The body terminated at its free end in a lophophore carrying from eighteen to twenty-seven tentacles. The foot was destitute of a lateral expansion and of a foot gland, such as are found in several other species of this genus. Buds occurred attached to the anterior side of the body, nearly over the junction of the œsophagus with the stomach. Ovaries were present in all the individuals, but testes could not be found. Whether the species has separate sexes or is protandric must be left undetermined. There are three characteristics in which *Loxosoma Davenportii* differs markedly from other species of this genus. The first of these is the possession of a single

row of large cells lying in the wall of the body and extending along the mid-dorsal line from the base of the stalk to the vicinity of the arms. A second but not invariable characteristic is the presence of one or more flask-shaped organs attached to the wall of the body near the basal end of the stomach and projecting slightly forward. The third characteristic is a modification of the epithelial wall of the vestibule shown by those individuals which have developing larvæ, and consisting in part of irregular, tongue-shaped projections, whose free ends may be invaginated and filled with a yolk-like material. This substance may float out into the vestibule. The modified epithelium, as well as this yolk-like substance, forms a source of food for the developing larvæ.

Pleurivalent Spermatids and Giant Spermatozoa and their Relation to the Centrosome Question. F. C. PAULMIER. (Presented by E. B. Wilson.)

AMONG the spermatids in *Anasa tristis* occasionally occur those whose nuclei are double or quadruple the usual size, the cell body being correspondingly enlarged. While otherwise normal, the double ones have two centrosomes and two axial filiaments.

These giant spermatids are due, the double ones to the non-completion of the second spermatocyte division, the quadruple ones to the non-completion of both divisions.

In the normal univalent spermatid the single centrosome persistent throughout the period of spermatocyte growth and division apparently disappears and comes into view later upon the other side of the nucleus. Is this disappearence real or only apparent?

In the bivalent spermatids the two centrosomes of the second division apparently disappear and two reappear at a later stage in the Nebenkern. In the quadrivalent ones the four centrosomes of the first division (the original two having divided early in preparation for the second division) apparently disappear, and later four appear in the Nebenkern.

This fact that the same number of centrosomes which disappear—namely, two or four—always reappear seems to prove that the disappearance is only apparent and indicates that the centrosome persists in some form, perhaps hidden by the chromatin.

The Maturation of the Egg under Different Conditions. A. D. MEAD.

THE behavior of the Chætopterus ovum when subjected to different conditions shows that many of the phenomena of maturation and karyokinesis, which usually appear to be correlated with one another, are in reality independent.

When the egg is allowed to remain unfertilized in normal sea-water the maturation proceeds only as far as the metaphase of the first spindle. When, however, the egg is (*a*) fertilized with one spermatozoon, (*b*) fertilized with several spermatozoa, or (*c*) placed unfertilized in a solution of potassium chloride, the polar globules are extruded in a perfectly regular and uniform manner, and certain characteristic changes in the contour of the egg take place in all.

Although these phenomena are the same, the appearance of the greater part of the cytoplasm of the egg is widely different in the various cases. To illustrate: The formation of the second polar globule, the reconstitution of the egg-nucleus and its migration toward the egg center, occurs in the same manner whether (*a*) the egg contains a sperm-nucleus and one huge sperm-amphiaster, whether (*b*) it contains a number of sperm-nuclei and sperm-amphiasters, or whether (*c*) it contains no sperm-nucleus or radiation in the cytoplasm.

Some Activities of the Polar Bodies in Cerebratulus. E. A. ANDREWS.

It is well known that some one-celled animals form 'filose pseudopodia,' that is, temporary, fine threads of flowing sensitive protoplasm. These serve for locomotion, taking-in of food, tactile organ, etc., *i. e.*, for relation with environment.

A recent statement that the cells and polar bodies in sea-urchin and starfish eggs put forth similar threads and so establish amongst themselves temporary living connections led the speaker to examine other animals. Filose phenomena were seen in the living eggs of an Annelid, a Gasteropod and a Lamellibranch, while preserved vertebrate material indicated their presence there also.

In the large Nemertian worm, *Cerebratulus lacteus* Verrill, the filose activities of the polar bodies are less difficult to see than those described in Echinoderms, and differ characteristically from them. Diagrams made from a series of camera drawings covering several hours' continuous observation showed that the polar bodies are very active in change of shape and in filose protrusions.

Each polar body has its special habit of action. In each there is a progressive specialization of activity. The polar bodies look not unlike Radiolarians, and when the second becomes of a spindle shape, with stars of filaments at its poles, it suggests the amphiaster stage in karyokinetic cell-division. This resemblance, so far as the star-like groups of filaments are concerned, is not superficial, if we accept* the statement that the astral rays in the starfish egg are often delicate, filose extensions of the contractile protoplasm between vesicles of an emulsion that makes up the egg; for then the internal stars and external stars are both expressions of the same contractile power and filose habit of protoplasm. Thus the filose powers of protoplasm are shown to us through various striæ, filaments, rays and threads within cells, as well as through those hitherto unsuspected, delicate, flowing, thread-like, pseudopodial extensions external to, and amongst, the cells of Metazoan masses.

The Effect of Salt Solutions on Unfertilized Eggs of Arbacia. T. H. Morgan.

If unfertilized eggs of Arbacia are put into sea water, to which 1.5 per cent. sodium chloride has been added and left there from one to three hours, they will, when returned to ordinary sea water, begin to segment after about half an hour. The division is sometimes into two parts, oftener into more than two parts, and does not in any way resemble the normal cleavage. These eggs continue to divide for at least twelve hours, but do not develop into embryos.

Sections show that the female pronucleus persists in the egg in the salt solution from two to four hours. After that time the nuclear wall disappears and the chromosomes are set free in the cytoplasm, usually in the form of a dense cluster. During the time that the eggs are in the salt solution the artificial astrospheres that have been described for fertilized eggs appear. When the eggs were returned to ordinary sea water the chromosomes separate and probably divide. The rays of the artificial astrospheres that come in contact with the chromosomes thicken and become less granular. The chromosomes now begin to migrate towards the centers of the surrounding astrospheres. Later the chromosomes form resting nuclei, two or more. Around these nuclei as centers the protoplasm begins to constrict, forming the cleavage spheres seen from the surface. Half an hour later the nuclei again resolve themselves into chromosomes and a new division, etc., succeed.

The artificial astrospheres slowly fade

*The Living Substance: As Such and as Organism. G. F. Andrews. Ginn & Co. 1897.

out and take no further part in subsequent divisions. The spindles that form after this time are very small and resemble the central spindle described by R. Hertwig for other echinoderm-eggs. The experiment shows that the additional sodium chloride added to the sea water acts as a stimulus on the nucleus, starting in it a series of changes leading to a division and separation of the chromosomes. The effect lasts through a long series of subsequent divisions. The artificial asters, as long as present, seem to act as centers towards which the chromosomes move. The rays of the astrospheres that come in contact with the chromosomes change their structure in very much the same way as do the rays that form the spindle in the ordinary karyokinetic figure.

Centrosome and Sphere in the Fertilized Egg of Unio. F. R. Lillie.

Starting with the typical structure of the aster in the metaphase of either maturation spindle, viz.: A small centrosome with the radiations inserted in it, and surrounded by inner and outer strata of microsomes forming inner and outer spheres, it was shown that by fusion of the stratum of microsomes bounding the inner sphere and by peripheral accumulation of its ground substance, the inner sphere is converted into a vesicle during the anaphase and telephase of both maturation divisions. This vesicle is now the central area of attachment of the radiations; and the centrosome proper is attached to the wall of the sphere by fibers, which are not part of the general system of radiations.

It was shown further that the central spindle of the second maturation division is formed within the inner sphere, and that during the prophase the centrosomes increase greatly in size and *fragment* into a number of *centrosome granules*, one of which remains as the centrosomes of the later stages (mother-star and later), while the others form in part the stratum of microsomes bounding the inner sphere, and in part become resolved into the ground substance of the inner sphere.

Combining these results with those announced before the Society in the winter of 1896 (Science, V., 114, March 5, 1897), the study of the maturation and fertilization of the egg of *Unio* was stated to offer the following evidence against the theory of the permanence and uniqueness of the centrosome:

1. A sperm amphiaster is formed, but it disappears utterly at the time of the metaphase of the first maturation spindle.

2. Entirely independently of the sperm and egg asters, there arises in the egg of *Unio* at the time of the metaphase of the second maturation spindle an accessory aster, in the center of which is a minute centrosome. This centrosome divides and a small amphiaster is formed, which entirely disappears at the beginning of the telephase.

3. After the formation of the second polar globule the egg centrosome goes the way of its kind (*i. e.*, disappears).

4. The two cleavage centrosomes arise independently of any of their predecessors, and apparently separately.

5. Fission products of the centrosomes become cytomicrosomes.

Thus the egg of *Unio* furnishes evidence, in the first place, that the centrosomes are not genetically continuous; in the second place, that a centrosome may arise *de novo* (accessory aster); and, in the third place, that products of division of the centrosome may become other formed elements of the cell.

A somewhat fuller statement is to appear in the *Zoological Bulletin*

The Fertilization of the Egg of Molgula Manhattensis. H. E. Crampton, Jr.

Upon deposition, a series of changes is inaugurated leading to the formation, entirely from the germinal vesicle, of a barrel-shaped maturation spindle. *This spindle is devoid*, as far as can be ascertained, *of centrosomes, asters, centrospheres*, etc., at both ends. The spindle moves as a whole to the periphery, the sixteen chromosomes divide, the daughter chromosomes diverge to the head of the barrel, and the first polar body is extruded. The spindle fibers withdraw from the chromosomes and condense at the middle of the extent, forming a dense Zwischenkörper. A second maturation spindle is formed, a counterpart of the first, except that eight chromosomes pass into the second polar body, while eight remain in the egg. A vesicular nucleus is formed by these latter. The polar bodies arise at the area destined to be the vegetative pole.

The sperm enters at or near the future animal pole. The sperm-head is preceded by a double centrosome, surrounded by a distinct aster. The centrosomes diverge, as they progress inwards, each surrounded by an aster, but without any fibers passing between them comparable to the 'central spindle' of the annelid, mollusk and other types. After the asters have taken up their positions for the future cleavage-figure the now vesicular sperm-nucleus and the egg-nucleus take up their positions side by side midway between the asters.

A *barrel-shaped spindle*, precisely similar to that of the maturation stages, is formed *entirely from the segmentation nucleus.* The presence of an aster and a double centrosome at either end of the figure gives the appearance of a continuous spindle passing from center to center. Such, however, is not the case. After division of the chromosomes the daughter products diverge only to the heads of the barrel, not one-half the distance to the centrosome. There they become vesicular and ultimately fuse, while the spindle-fibers withdraw from them to form a 'Zwischenkörper,' as in the maturation stages. Only then does the cell divide. And only after the formation of the vesicular daughter-nucleus do the two centrosomes in each cell move apart. When they do, the daughter-nucleus moves up between them, and the series is repeated. A comparative independence, then, of the processes undergone by the nucleus on the one hand, and the centrosomes and asters on the other, is indicated.

The Asters in Fertilization and Cleavage. E. G. Conklin.

In *Crepidula* and several other genera of marine gasteropods there is a well-marked centrosome and sphere in both polar spindles. In the metaphase this centrosome is a single densely-staining body; in the anaphase it greatly enlarges, and the center of the body does not stain; in the telephase it becomes a large sphere with an extremely thin surface layer, containing a large number of coarse granules. During the metamorphosis the centrosome has changed its staining reactions; in the prophase and metaphase it takes only nuclear stains; in the telephase it takes only plasma stains, while in the anaphase it takes both.

Though the spermatozoon frequently enters before the first polar body is formed no sperm aster appears until the metaphase of the second polar spindle. This aster is large and conspicuous, though not as large as the aster of the second polar spindle which remains in the egg; it frequently contains several dark-staining granules. At the same time one or more accessory asters appear in the egg; these are much smaller than either the egg or sperm aster, and no centrosome could be found in them. The sperm and egg asters become very large and have the same structure and staining reactions, the radiatio nsfrom them proceeding for some distance through

the egg. Each remains in close contact with its own nucleus, so that there is no possibility of confusing and mistaking them. When the pronuclei come together the asters also come into contact. The origin of the cleavage centrosomes has not yet been satisfactorily determined.

In the prophase of the first cleavage the chromatin is clearly distinguishable into two kinds, oxychromatin and basichromatin; the latter only takes part in forming the chromosomes; the former becomes arranged like beads on the spindle fibers and is apparently drawn to the two poles. It seems to take no part in the formation of the daughter nuclei and probably forms a part of the granular substance of the sphere. All the cleavage centrosomes undergo a metamorphosis similar to that of the polar spindles and in the telephase of each cleavage the poles of the spindle are occupied by a granular sphere frequently as large as the nucleus, or even larger. These spheres, in every case, move to those portions of the cells which lie nearest the polar bodies. In this position they can be recognized through one and, in some cases, two or three subsequent divisions. It results from the fact that after the first two cleavages the sphere substance is differently distributed to the different cells, the entire sphere substance of one generation always going into those cells of the next generation which lie nearest the animal pole. This differential distribution of the spheres has been followed through every cleavage up to the 24-cell stage. As the form of cleavage is perfectly constant it follows that the sphere substance of any generation goes into certain definite cells which have a perfectly constant origin and destiny. This differential distribution of the spheres is not caused by their specific weight, since their movements are the same in whatever position the egg may be placed. It seems to be the result of a form of polarity which, like that of the egg itself, is not the result of gravity.

The centrosomes do not apparently arise from the sphere substance of the previous division, but some distance from it, and the sphere substance itself never divides, but each sphere ultimately grows ragged at its periphery and gradually fades out into the general cytoplasm.

The differential distribution of these spheres and their subsequent conversion into cytoplasm suggests that they may be important factors in the differentiation of the cleavage cells, and if further investigation should establish the fact that they are in part composed of the oxychromatin of the nucleus it would furnish a basis, in fact, for certain well known speculations of DeVries, Weismann and Roux.

Considerations on Cell-lineage and Ancestral Reminiscence, based on a Re-examination of Some Points in the Early Development of Annelids and Polyclades. Edmund B. Wilson.

This paper attempted to reconcile the apparent contradiction in cell-lineage between the annelids and polyclades, and to show that homology and ancestral reminiscence may appear as clearly in the cleavage period as in other stages. In *Leptoplana*, a polyclade, all of the first quartets of micromeres produce ectoblast, as in the annelids or mollusks, while the main mass, if not all, of the mesoblast arises by delamination from the second quartet. The formation of ecto-mesoblast ('larval mesenchyme,' or 'secondary mesoblast') from cells of the second or third quartets in the mollusks was interpreted as a reminiscence of what occurs in the polyclade, and evidence was given that a similar reminiscence occurs in some annelids (*Aricia*).

In the polyclade the fourth quartet is purely entoblastic; but the posterior cell

divides symmetrically, always (*Discocœlis*?), or occasionally (*Leptoplana*). This cell is probably to be regarded as the prototype of the second somatoblast of annelids and mollusks, which divides symmetrically to form the 'primary mesoblasts,' the mesoblast bands (ento-mesoblast) being a new formation and the ecto-mesoblast ('larval mesenchyme,' etc.) being homologous with the mesoblast of the polyclades. This interpretation is sustained by the fact that the posterior cell of the fourth quartet may contain entoblastic elements largely developed (*Crepidula*), considerably reduced (*Nereis*) or reduced to a pair of rudimentary or vestigial cells (*Aricia*, *Spio*). The latter strikingly illustrate ancestral reminiscence in cell-lineage, and represent the penultimate stage in a series which begins with the polyclade. These facts and others were urged in support of the cell theory of develment and the value of cell-lineage in the investigation of homologies.

The Characters and Phylogeny of the Amblypoda. H. F. Osborn.

As a result of the recent explorations by the American Museum of Natural History, a complete skeleton of *Coryphodon* has been procured and mounted, as well as a nearly complete skeleton of *Pantolambda*, not only one of the oldest geological, but the most archaic type of ungulate, from a morphological standpoint, hitherto discovered. The restoration of this animal shows it was completely plantigrade, progressing upon the plantar and palmar surfaces of the feet, like a bear. There is an os-centrale carpi as in the *Creodonta*, and the whole skeleton, is strongly impressed with the Creodont type, reinforcing the evidence already derived from the Phenacodontidæ, that the Ungulata sprang from Unguiculate animals. This restoration agrees with a prior restoration of *Periptychus*, and the resemblances between these two skeletons are very marked, supporting the author's views expressed in 1893, that *Periptychus* should be placed among the Amblypoda. This gives this very ancient order of ungulates a very wide functional variation from small arboreal types to the huge *Uintatheres* of the Eocene. The evolution of the skull can now be fully traced out, and in *Coryphodon* we observe the rudiments of the frontal and parietal horns of *Uintatherium*.

A Series of Specimens Illustrating the Development of the Chick. Mrs. S. P. Gage.

These illustrate Professor Gage's idea that in an embryological series for a museum all stages sufficiently different to be easily recognized by the naked eye are to be included, to the adult condition. They are the unincubated germ, the 12, 18, 24, 36, 48, 60, 72 and 96-hour chick; and from this point on to hatching are at intervals of one day, ending with a chick just emerging from the shell at the 21st day. Mounted skins of chicks 24 hours and six days after hatching, of one in the stage known commercially as a broiler and of a hen and rooster complete the series.

All the specimens were fixed in 10 per cent. nitric acid, washed to free from yolk and preserved in alcohol. From the 7th day on, the membranes were too extensive to show both them and the chick, and parallel series were arranged in the same jar, one to exhibit the chick and one the membranes.

The earlier stages were mounted on cover glasses, which had been albumenized and built up in a slightly convex form with collodion and brushed with a coating of collodion containing lamp black. The germ was floated on to the cover under alcohol and fixed in place by thin collodion. Glass strips to fit the jars were prepared by albumenizing and (unless the glass were black) coating with thin collodion containing lamp black, thus giving a strongly con-

trasting background. The cover glasses were mounted on the glass strips and held in position by collodion.

For the older stages, where the membranes stretch far around the yolk, thick (6 per cent.) collodion was moulded in Reighard's watch glasses, hardened in chloroform and coated with black collodion. The membranes were then floated over the mass, fixed in position with thin collodion, and these mounted specimens without membranes were fastened in position on the glass slides with collodion.

A separate series was made to show the change of form of the brain in course of development.

On the Amblyopsidæ. C. H. EIGENMANN.

THE members of the Amblyopsidæ and their distribution are as follows: *Chologaster cornutus*, abundant in the lowland swamps of Virginia and Georgia; *Chologaster Agassizii*, subterranean streams of Tennessee and Kentucky; *Chologaster papilliferus*, springs of Union and Jackson counties, Ill.; *Amblyopsis spelæus*, subterranean streams of the Ohio Valley; *Typhlichthys subterraneus*, subterranean streams of the Ohio Valley, chiefly south of the Ohio River; *Typhlichthys rosæ*, subterranean streams west of the Mississippi.

The eyes of all the species except those of *Ch. Agassizii* have been examined. In *Chologaster* the eyes are normally placed and functional. *Ch. papilliferus* possesses the better eyes, but even here many signs of degeneration are apparent, the inner layers of the retina being less in thickness than the pigmented layer. In *Ch. cornutus* the pigmented layer forms two-thirds of the thickness of the retina, the nuclear layers are each composed of a single series of nuclei and the ganglionic layer of cells widely separated from each other. The lens and vitreal body are normal. In all the species examined the eyes have sunk beneath the surface, the lens and vitreal body have practically disappeared; the eye has, as a consequence, collapsed and is minute. Part of the ganglionic layer forms a central core of cells in *Amblyopsis* and *T. subterraneus.* In the former the pigmented layer is highly developed; in the latter, while still present, it is entirely without pigment. In *T. rosæ* the eye has degenerated further than in the eastern species. The central core of ganglionic cells has disappeared; the pigmented layer is imperfect; the inner reticular layer occupies a central, or rather posterior, position around which the nuclear layers are placed. Lens and iris are gone, and the entire eye is but 40–50 μ in diameter.

Conclusions: The three species of blind fish are of independent origin. The results of degeneration are not the same on the homologous structure of the eye in the three species. The degeneration is not the result of arrested development or of ontogenic degeneration. The eye of the Amblyopsidæ, reaching its greatest point of degeneration in *T. rosæ*, is the result of phyletic degeneration begun before the fish entered the caves. Their degenerate eyes are not primarily due to their habitat in caves, *i. e.*, to the absence of light; rather are they found in the caves because they were largely able to do without the use of their eyes, and therefore succeeded in establishing themselves in the caves. In this they were aided by their peculiar method of raising their young in their gill cavities.

The two Common New England Salamanders, Desmognathus and Spelerpes, and their Importance as Laboratory Animals. H. H. WILDER. (Read by title only.)

Accessory Optic Vesicles in the Chick Embryo. W. A. LOCY.

IT was shown that in chick embryos two distinct sets of vesicles make their appear-

ance in the neural tube: A transitory set that arise in connection with the original optic differentiation, and which completely disappear before the second set or true brain vesicles arise. The lateral expansions of the neural tube which constitute the beginning of the eye vesicles are elongated, and they are converted into the true optic vesicles in front and a succession of similar but smaller ones which are serially arranged behind the former. The latter series, which consists of six pairs of vesicles, is very transitory, passing through the stages of rise, culmination and decline within three or four hours' time.

The structures occur in normal embryos. Five hundred eggs were incubated and fifty embryos obtained at the right ages to show the history of these structures. They were studied in living specimens in warm salt solution. The observations were originally made in 1893 and verified and reverified in a variety of ways since that time. The specimens were sketched, photographed, sectioned and, in some cases, reconstructed. By placing the specimens under a dissecting microscope, where several can be viewed at the same time, and making a critical *comparative* study of all the embryos, they may be arranged in a graded series, the extremes of which differ considerably, but the intermediate embryos show slight gradations. In such a series it is observed that these vesicles do not, in any case, develop progressively to become brain vesicles, but undergo decline before the brain vesicles appear. At their period of greatest development—between the 24th and 26th hour, with six somites—there are six pairs; they are reduced during the next hour to four pairs, and, at about the 27th hour, with eight somites, they are reduced to two, which rapidly fade away. From this period the true brain vesicles begin to appear. The author's observations on the development of the brain vesicles agree with those of Duval, Platt and other observers. It was shown that the first set of vesicles are independent of the brain vesicles and have not before been figured.

The theoretical bearing of the facts is obvious, and, although the author designates these structures 'accessory optic vesicles,' from their connection with the original optic differentiation and from their resemblance to the primary optic vesicles, nevertheless he holds this view in the lightest way, ready to withdraw it whenever any better interpretation may be presented. The validity of the facts is held to be established, and their history has been carefully worked out. Demonstrations of these structures to those interested followed.

The Thoracic Derivatives of the Post-cardinal Veins in Swine. G. H. PARKER.

EMBRYONIC pigs of about six millimeters greatest length possess well developed right and left post-cardinals (posterior cardinal veins) which extend from the base of the corresponding posterior extremities anteriorly over the dorsal surfaces of the Wolffian bodies to the region of the heart. The thoracic portion of each post-cardinal persists from the region of the heart to the tenth pair of ribs, beyond which a new vessel, the accessory vein, is developed, reaching to a point some distance posterior to the last pair of ribs. The combination of the post-cardinal and accessory vein of the right side gives rise to the azygos vein; the corresponding veins of the left side produce the hemiazygos. The axygos and hemiazygos veins receive the intercostal veins of their respective sides, and become mutually connected by several transverse veins. In later embryonic life the cardinal portion of the azygos vein usually degenerates completely, and the right intercostal veins connected with this part find outlets through the corresponding part of the hemiazygos which persists in the adult pig. The

accessory parts of the azygos and hemiazygos veins may remain connected with the cardinal part of the hemiazygos and by their variations give rise to three structural types: First, one in which both accessory parts are equally developed; secondly, one in which the hemiazygos accessory part predominates; and thirdly, one in which the azygos accessory part predominates.

The Veins of the Wolffian Body. C. S. MINOT.

DR. MINOT had studied especially the condition in pig-embryos of 12.0 mm. The cardinal vein ends abruptly at the cephalic end of the Wolffian body; the vena cava inferior is also well developed and communicates widely with the middle of each mesonephros. Between the Wolffian tubules there are no capillaries, but only large sinuses, the endothelium of which lies close against the epithelium of the tubules. The sinuses communicate freely with both the cardinal and cava veins. Along the dorsal side of the Wolffian body there is no continuous cardinal vein, but there are still two channels of reduced size, representing the lower parts of the cardinal which have become united with the cava inferior.

New Embryological Observations. C. S. MINOT.

THE author described: (1) the mesothelial villi of the allantois in the pig; (2) the development of the hypophysis and infundibular gland in the pig, *Amia*, *Batrachus*, *Ameiurus* and *Necturus*, confirming and extending the results of Béla Haller; (3) observations upon various vertebrate types, tending to show that the zones of His have a constant morphological value; (4) the fore-brain of *Ameiurus Embryos*, clearly similar to that of other types of vertebrates as concerns the hemispheres and foramen of Monro; if this observation is confirmed by further study it will show that neither the theory of Burkhardt nor that of Studniscka in regard to homologies of the Teleostean fore-brain is correct.

A Peculiar Glandular Structure found in a Mexican Diplopod. F. C. KENYON. (Read by title only.)

THE structure was found in the repugnatorial glands of specimens of the diplopod genus *Platydesmus* from Mexico. It arises from the proximal inner surface of the walls of the bottle-shaped repugnatorial gland and projects into the glandular cavity, presenting in section very much the appearance of a section of an ordinary mushroom and its stalk. Its base and the distal, or expanded cap-like portion, are well provided with medium-sized, somewhat oval nuclei. The stalk exhibits a striated appearance. In the expanded cap only fragments of cell boundaries have been distinguished.

In some respects the organ resembles the structure that has been figured for the phosphorescent organs of some deep-sea animals, but *Platydesmus* is not known to have the power of emitting phosphorescent light, and only one diplopod has ever been described as having such a power. In this one form, *Fontaria luminosa* Ken., the light was described by the person who observed it as arising from spots corresponding in position to the repugnatorial glands. A light-emitting function is suggested for the peculiar structure noted. Whether the suggestion will eventually prove to be a fact, however, is a question which the collector must be largely depended upon to decide.

The following officers were elected for the ensuing year: President, Henry F. Osborn, Columbia; Vice-President, T. H. Morgan, Bryn Mawr; Secretary-Treasurer, G. H. Parker, Harvard; Members of the Executive Committee from the Society at large, C. B. Davenport, Harvard, and F. R. Lillie, Michigan.

G. H. PARKER,
Secretary.

HARVARD UNIVERSITY.

A. JOLY.

The recent death of Professor A. Joly, director of the chemical laboratory of the École Normale Supérieure and professor in the Paris Faculty of Sciences, deserves more than passing mention. His early work was as an assistant in the laboratory of Sainte-Claire Deville, and later he became sub-director of the École Normale laboratory under Debray, whom he succeeded. His first published work (1875–7) was on columbium and tantalum, in which he added much to our knowledge of these rare elements, formed synthetically several of the rare columbium minerals, and proved the non-existence of Marignac's *ilmenium.* His next work (1882–7) was on the general and thermal chemistry of the acids of phosphorus and arsenic, among the points touched upon being the relations of these acids and baric acid to indicators. No less than twenty-four papers, mostly published in the *Comptes Rendus,* belong to this period. It was at this time, too, that he made a study of the carbid of boron, as he had earlier that of columbium, and carried this work as far as was possible till the introduction of Moissan's electrical furnace.

Joly's most important work dates from 1888, when he entered upon the study of the rarer elements of the platinum group, beginning, in conjunction with Debray, upon the oxids of ruthenium. Potassium ruthenate and perruthenate were for the first time obtained in a pure and crystallized condition; the supposed tetrachlorid of ruthenium of Claus, having an analogous formula to that of the chlorids of the other platinum metals, was shown to be not $RuCl_4$, but $RuCl_3NO$, a nitroso-chlorid, in which the NO group acts in the place of a halogen atom; several new series of ruthenium ammonium bases were formed, among them one derived from the nitroso-chlorid—'ruthenium red'—which possesses wonderful tinctorial powers, closely resembling an organic dyestuff. It has been used in histology and bacteriology, and is said to be the 'only reagent for the products of transformation of pectic compounds.'

In other papers the constitution of osmiamic acid of Fritsche and Strure was at last cleared up, it proving to be a nitroso compound; the double nitrites of the platinum metals were studied, and their action when decomposed by heat; and a new method was devised for separating the platinum metals. Atomic weight determinations of ruthenium, iridium and palladium were made, the first being particularly valuable, as there had been no work on this since that of Claus, and Joly's determination brought ruthenium into its proper place in the periodic table. By means of the electric furnace Joly was enabled for the first time to obtain ruthenium and osmium in a coherent state and to study the properties of the fused metals.

Altogether in his less than a quarter of a century of work Joly published about sixty papers, a number of the later ones in conjunction with Vèzes and Leidié. He was the author of numerous articles in the Encyclopédie Chimique (Dunod), and the author of a number of text-books, which have been through several editions: Élémens de chimie; Cours élémentaire de chimie et de manipulations chimiques, 3 vols; and Cours élémentaire de chimie (notation atomique), 3 vols. Professor Joly was one of the relatively few chemists whose lives have been devoted to inorganic chemistry, and who, working over and clearing up old fields once passed over but yet little explored, rather than penetrating into wholly unknown regions, has thereby served to put chemistry on a firmer basis. Dead at only fifty-one years of age, he can be ill spared.

Jas. Lewis Howe.

THE FIRST AWARD OF THE LOBACHÉVSKI PRIZE.

THE Lobachévski prize is adjudged every three years. Its value is five hundred roubles. It is given for work in geometry, preferably non-Euclidean geometry. All works published within the six years preceding the award of the prize, and sent by their authors to the Physico-Mathematical Society of Kazan, are allowed to compete if published in Russian, French, German, English, Italian or Latin.

The Society has now in formal session awarded the prize to Sophus Lie, professor of mathematics at the University of Leipzig, for his work 'Theorie der Transformationsgruppen, Band III., Leipzig, 1893.' In this work the theory of non-Euclidean geometry has been exhaustively re-stated and re-established in a profound investigation of the work of Helmholtz on the space-problem.

To the genius of Helmholtz is due the conception of studying the essential characteristics of a space by a consideration of the movements possible therein.

But since the time when Helmholtz did his work on this subject the greatest of living mathematicians, Sophus Lie, formerly of Christiania, has enriched mathematics with a new instrument, the Theory of Groups, which its creator has applied with tremendous power to the Helmholtz treatment. Lie finds, as was almost inevitable, that certain details had escaped the great physicist, but that, with the tact of true genius, he had kept his main results free from error, though there comes to light a superfluity in his explicit assumptions, an unconscious assumption now seen to be mathematically important for the rigor of the demonstration, and at least one definite error in minor results.

Lie's method is in general the following. Consider a tri-dimensional space, in which a point is defined by three quantities, x, y, z.

A movement is defined by three equations:

$x' = f\ (x, y, z)\ ;\ y' = \varphi\ (x, y, z,)\ ;\ z' = \Psi\ (x, y, z)$.

By this transformation an assemblage, A, of points (x, y, z) becomes an assemblage, A$'$, of points (x', y', z').

This represents a movement which changes A to A$'$.

Now make, in regard to the space to be studied, the following assumptions:

1st. Assume: In reference to any pair of points which are moved, there is *something* which is left unchanged by the motion.

That is, after an assemblage of points, A, has been turned by a single motion into an assemblage of points, A$'$, there is a certain function, F, of the coordinates of any pair of the old points (x_1, y_1, z_1), (x_2, y_2, z_2) which equals that same function, F, of the corresponding new coordinates (x'_1, y'_1, z'_1), (x'_2, y'_2, z'_2); that is, $F\ (x_1, y_1, z_1, x_2, y_2, z_2) = F\ (x'_1, y'_1, z'_1, x'_2, y'_2, z'_2)$.

This *something* corresponds to the Cayley definition of the distance of two points when interpreted as completely independent of ordinary measurement by superposition of an unchanging sect as unit for length.

This independence, involving the determination of cross-ratio without any use of ordinary ratio, without using congruence, without using motion, Cayley never clearly saw. It follows from the profound pure projective geometry of von Staudt.

2d. Assume: If one point of an assemblage is fixed, every other point of this assemblage, *without any exception*, describes a surface (a two-dimensional aggregate).

When two points are fixed a point in general (exceptions being possible) describes a curve (a one-dimensional aggregate). Finally, if three arbitrary points are fixed, all are fixed (exceptions being possible). With these assumptions Lie proves exhaustively that the general results

of Helmholtz and Riemann follow; that is, there are three, and only three, spaces which fulfill these requirements, namely, the traditional, or Euclidean space, and the spaces in which the group of movements possible is the projective group transforming into itself one or the other of the surfaces of the second degree

$$x^2 + y^2 + z^2 \pm 1 = 0.$$

In the appreciation of this work of Lie's, prepared for the Society by Felix Klein, for which the Lobachévski gold medal was given him, he says that Lie's work stands out so prominently over all the others to be compared with it that a doubt as to the award of the prize would scarcely have been possible. Decisive for this judgment as to the height of the scientific achievement is not only the extraordinary depth and keenness with which Lie, in the fifth section of his book, handles what he has called the Riemann-Helmholtz space problem, but especially the circumstance that this treatment appears, so to say, as logical consequence of Lie's long-continued creative work in the province of geometry, especially his theory of continuous transformation groups.

The extraordinary importance which the works of Lie possess for the general development of geometry can scarcely be overestimated. In the coming years they will be still more widely prized than hitherto. Passing, then, to the consideration of the present state of the space question, Klein takes up the origin of axioms. Whence come the axioms? A mathematician who knows the non-Euclidean theories would scarcely maintain the position of earlier times that the axioms as to their concrete content are necessities of the inner intuition.

What to the uninitiated appears as such necessity shows itself, after long occupation with the non-Euclidian problems, as the result of very complex processes, and especially education and habit.

Do the axioms come from experience? Helmholtz energetically says yes! as is well known. But his expositions seem in a definite direction incomplete.

One will, in thinking over these, willingly admit that experience plays an important part in the formation of axioms, but will notice that just the point especially interesting to the mathematician remains untouched by Helmholtz.

It is a question of a process which we always complete in exactly the same way in the theoretical handling of any empirical data, and which, therefore, may seem quite clear to the scientist.

Expressed generally: *Always the results of any observations hold good only within definite limits of precision and under particular conditions; when we set up the axioms we put in the place of these results statements of absolute precision and generality.*

In this 'idealizing' of empirical data lies, in my opinion, the peculiar essence of axioms. Therein our addition is limited in its arbitrariness at first only by this, that it must cling to the results of experience and, on the other hand, introduce no logical contradiction.

Then enters as regulator also that which Mach calls the 'economy of thinking.' No one will rationally hold fast to a more complicated system of axioms when he sees that with a simpler system he already completely attains the exactitude requisite to the representation of the empirical data.

Klein goes on to mention the possibility of a series of topologically distinguishable space-forms built of limited (simply compendent) space-pieces either all Euclidean, all Lobachévskian or all Riemannian. Beside these three just mentioned family-types, the parabolic, the hyperbolic, the single elliptic, Klein has shown that the spherical, in which two geodetics always

cut in two points, is the only one which as a whole is freely movable in itself.

Then Klein says: "I consider all the topologically distinguished space-forms as equally compatible with experience. That in our theoretic considerations we prefer some of these space-forms (namely, the family types, that is, the properly parabolic, hyperbolic, elliptic) in order to finally assume the parabolic geometry, that is, the customary Euclidean geometry, as valid, happens simply from the principle of economy."

GEORGE BRUCE HALSTED.
AUSTIN, TEXAS.

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*EARTHQUAKE SHOCKS IN GILES CO., VA.**

IMMEDIATELY following the earthquake of May 31, 1897, which was distinctly felt over most of the eastern portion of the United States, came newspaper reports of continued disturbance in the form of explosions and earth tremors in Giles county, Virginia. It was also reported that Mountain Lake had been drained, that the wells of Saltville, Virginia, had ceased to flow, and that large fissures had opened in the earth at various points in Giles county. At the urgent request of several citizens of Pearisburg, and with the idea that possibly there might be some foundation for the rumors afloat, I visited the region in the early part of June. The reports were found to be grossly exaggerated, as no disturbance had occurred at Mountain Lake, the Saltville wells were flowing as usual, and no fissures had appeared within the limits of Giles county. Under the circumstances the scientific results of my visit were insignificant, but there were certain phenomena observed which seemed to be worth recording.

The county of Giles lies on the northwestern side of the Appalachian Valley. Its surface is diversified by numerous ridges which cross the country from northeast to southwest. The rocks have been thrown into great folds, and are broken by numerous faults which also cross the region in the same direction. The principal object of my visit was to determine, if possible, whether there was any relation between the present disturbance and the geologic structure of the region; but, from the nature of the case, only a little information was obtained on the subject.

The earliest generally recognized earth tremor occurred on May 3. It loosened some bricks from old chimneys and was accompanied by considerable noise, like low rumbling thunder. From May 3 to 31 no shock of importance occurred, but many noises were heard, similar to the rumbling that accompanied the first quake. Many persons now believe that the same sort of noises occurred for a long time prior to May 3, but were passed unnoticed by the people, who, at that time, did not have their nerves wrought to such a tension that they heard and felt the slightest shock or earth tremor.

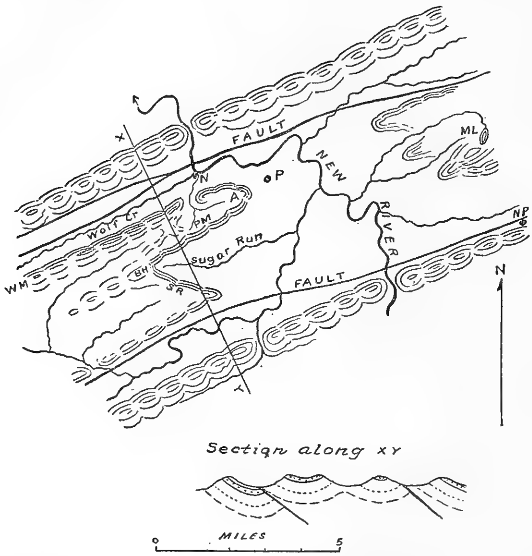
The shock of May 31 was probably more severe in and about Pearisburg than at any other point from which I have information. No serious damage was done even here, but old brick houses were badly shaken, and many chimneys were cracked and the topmost bricks hurled to the ground. Much noise accompanied this shock, and many of the inhabitants, already much disturbed by the previous heavy shock and the continued rumblings beneath them during the month, were terror-stricken. The noise did not stop with the main shock, but tremors and rumblings, or sharp reports, are described as occurring during the entire night following the shock. The intensity of these rumblings or reports varied according to location. Those of greatest severity were reported from the angle between Sugar Run and Pearis Mountains. Old veterans of the

* Published by permission of the Director of the United States Geological Survey.

war likened them to the reports of heavy siege guns fired at frequent intervals during the night.

From May 31 to the time of my visit, on June 6, the explosions are reported to have continued with considerable regularity, from five to ten slight shocks being about the daily average. During my stay of three days at Pearisburg I heard and felt a number of these explosions and tremors. Ordinarily I should not have noticed most of them, merely supposing them to be distant thunder. But a few were severe enough to jar the windows perceptibly. Since then, according to the reports of Mr. J. A. H. Shuler, the Baptist minister of the town, the shocks have been growing less and less in intensity and in frequency, until at the present time they are scarcely noticeable. Mr. Shuler estimates that there have been at least 250 distinct shocks observed at Pearisburg since the 3d of May.

The many conflicting reports of the inhabitants regarding the shocks made it almost impossible to arrive at any definite conclusion regarding the relation of the disturbance to the geologic structure of the region, but a few facts were noted which seem to have a bearing on this interesting question.



SKETCH MAP OF THE PEARISBURG REGION.

P—Pearisburg............WM Wolf Creek Mt.
N—Narrows..............PM Pearis Mt.
A—Angels' Rest..........SR Sugar Run Mt.
NP—Newport.
ML—Mountain Lake...BH Big Horse Gap.

Apparently the general shock of May 31st was most severely felt at the Narrows, which is located on one of the most complex and extensive faults of the region.

At this point the surface is said to have rolled like the groundswells of the ocean, springs were muddied and in some cases ceased to flow for a short time after the shock occurred, and a landslide of considerable proportions and a big rock rolled down off the face of Wolf Creek Mountain. The latter is no indication of great intensity, for the slopes of the mountain are so steep that a slide is liable to start at any time, and the blocks of sandstone have frequently such a precarious foothold that they will start with the slightest disturbance.

In the valley of Wolf Creek the testimony regarding the direction from which the explosions came is conflicting. Some thought that they came from immediately beneath, and some were equally certain that they came from the south—from the base of Wolf Creek Mountain. At Pearisburg there is a general agreement that the sounds and shocks always came from the west, or from the base of Angels' Rest. The shocks which I experienced at Pearisburg seemed to come from a little north of west, or from the direction of the Narrows, and they also appeared to come horizontally. In the Sugar Run region the general verdict was that they came from the north—from under Pearis Mountain, or from the west—from Big Horse Gap. In the vicinity of Pearisburg and Sugar Run the springs were disturbed, but not to the same extent as in the valley of Wolf Creek.

Pearis and Wolf Creek Mountains represent the two sides of a syncline whose point is formed by Angels' Rest. The strata of this basin are only slightly flexed, and it seems strange that it should be the seat of earth tremors. But when it is considered that the great fault along Wolf Creek valley dips toward the south at about 30 degrees it will be seen that the syncline is comparatively shallow and overlies the plane of the fault. Therefore, it seems probable that, instead of originating in the mountain proper, the disturbance came from movement along the fault plane underneath the mountain.

Movement along this fault plane is the only hypothesis I could formulate to account for the phenomena, but if such movement occurred it must have been so slight as to be unrecognizable at the surface. The reason for the pronounced disturbance in and about Pearisburg is presumably the cavernous condition of the limestone in that region, apparently causing it to act as a sounding board, magnifying the sounds and vibrations. Newport is also reported to have suffered considerably from the shocks; this can be accounted for by the hypothesis of movement on the fault, on which it also is located.

M. R. CAMPBELL.

WASHINGTON, D.C., December 18, 1897.

BOTANICAL NOTES.

DISTRIBUTION OF GOVERNMENT BOTANICAL PUBLICATIONS.

IT may not be generally known that there are many valuable publications from the several botanical divisions of the Department of Agriculture which may be obtained gratis or by the payment of a merely nominal sum. The Superintendent of Documents has issued a handy list of the publications now in his hands, with prices affixed. It will well repay every botanist not regularly receiving these publications to look over this list and secure valuable books and papers for but a slight cost.

A similar list has been issued by the Librarian of the Geological Survey of Canada (Ottawa), which contains the titles of many pamphlets and maps of much botanical value. The prices here again are very reasonable.

BAILEY'S LESSONS WITH PLANTS.

PROFESSOR BAILEY has again earned the gratitude of the public by bringing out a

new book upon plants. It need not be said to those who have read his books that this is not like other books on plants. It is new in matter, in illustrations and in method. We cannot make out whether or not it is to be used as a text-book. It is too full of suggestions for the humdrum of the ordinary class-room use. Perhaps its greatest value will be in affording stimulating suggestions to both teacher and pupil in primary and secondary schools.

The titles of the chapters are not so different from those in the familiar text-books of a generation ago. Thus we have 'Studies of Twigs and Buds,' 'Studies of Leaves and Foliage,' 'Studies of Flowers,' etc., but when we look at the treatment we find a newness and freshness which tell of the master who wrote the suggestive pages. The illustrator (Professor Holdsworth) and the publishers (The Macmillan Company) have done their share to give the book an attractive appearance.

CHARLES E. BESSEY.

CURRENT NOTES ON ANTHROPOLOGY.

ETHNOLOGIC MATERIAL FROM INDIA.

THE distinguished ethnologist Professor Bastian, after celebrating his seventieth birthday with eclat in Berlin two years ago, took a fresh start in his studies by going to India and adjacent regions, where he has been ever since, collecting most industriously all sorts of valuable knowledge. Many of his observations he has given out in a plain form in two volumes called 'Lose Blätter aus Indien,' published at Batavia. These are new contributions to the psychical ethnology which he has so earnestly advocated. I may dare to translate (no easy matter) from his preface to show the meaning of these studies: "The whole intellectual wealth of mankind, up to the most transcendental speculations, can be reduced to a minimal quantity of elementary thoughts, each potentially pregnant with magical powers, unfolding into the most varied national mental products, and satisfying the physical longings in every direction, under the correlation of cosmical harmonies, with which the processes of thought themselves are in necessary union."

In this spirit Professor Bastian takes up the mythology and philosophy of the far East, its ethics, its legends and its religious rites, throwing new light on what is old, and adding much that is novel and striking. To the reader who likes hard reading and deep thinking, the work may be commended as sure to satisfy.

ANCIENT VARIETIES OF DOGS.

THE first domesticated mammal seems to have been the dog. In the Swiss Society of Natural History, last year, Professor Studer read a paper on ancient European dogs. The oldest variety was the so-called peat dog. It belongs to the neolithic period. There were four other varieties known in the bronze period, and in that of the lake dwellings. Direct descendants of these are the German hunting hounds, the shepherd dog and the poodle.

In America there is little evidence that any dog was trained for hunting. In the far north the Eskimo dog was a beast of draught, the only one known to the Red Race. The dogs of Mexico and Central America seem to have been principally raised for food or ceremonial sacrifices. In Peru there were several varieties under domestication, two of which have been clearly distinguished.

It is noteworthy that although in many American tribes the dog was a sacred or mythical animal in the legends, he was not regarded with affection, but with dislike and aversion, a fact strongly brought out by von Tschudi.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

GEORGE MÉKER, in a recent *Comptes Rendus,* calls attention to the fact that, while fused sulfate of ammonium or the alkaline halids have little or no effect on platinum, a mixture of ammonium sulfate and bromid or potassium bromid corrodes the metal very rapidly. Platinum black or even finely divided metallic platinum, is rapidly brought into combination with this mixture at 330°, the bromo-platinate of ammonium being formed. The other metals of the platinum group have not been tested with this mixture by the author.

IT is many years since Dr. Künzel called attention to the fact that in a nickel solution containing potassium nitrite even traces of a calcium salt give a yellow precipitate. Several of these triple nitrites have been from time to time studied, and in the last *Zeitschrift für anorganische Chemie* Carl Przibylla gives a systematic study of these salts. $CuBaK_2(NO_2)_6$ may be taken as a type of the triple nitrites. The copper may be replaced by nickel or iron, the barium by calcium, strontium or lead, and the potassium by ammonium. The salts are very insoluble, not stable in the presence of water, and some of them appear to be mixtures, but even these mixtures closely approximate the above formula.

THE work of Melikoff and Pissarjewsky on peruranic acid was recently noticed in this column. According to their view of the constitution of this acid, its ammonium salt should contain ammonium peroxid, and their efforts to obtain this compound are the subject of a preliminary communication in the last *Berichte.* By mixing concentrated ether solutions of hydrogen peroxid and ammonia at —20°, a thick liquid was obtained which had little odor of ammonia, and which, on further cooling with liquid carbon dioxid, crystallized. Analysis of the crystals gave the composition $(NH_4)_2O_2, 2H_2O_2, 10H_2O$. The water of crystallization seems not to be constant, but the existence of the peroxid of ammonium of the formula $(NH_4)_2O_2, 2H_2O_2$ appears well established.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE TOTAL ECLIPSE OF THE SUN.*

THE observation of the total solar eclipse in India has been a magnificent success. Here at Talni, during the three weeks of our preparations, we never saw a single cloud and to-day has been as perfect as those which have preceded it, and whilst we are rejoicing over our own good fortune the news is flashed to us that at Buxar, in the east, and Jewar, in the west, observers have been equally favored. Thanks to the forethought of our host, Lieutenant Morris, no spectators were allowed to approach within several hundred yards of our camp, and we observed the superb spectacle free from the slightest interruption. The first encroachment of the dark body of the moon gave us an hour and a half's warning of totality, and slowly indeed did the first part of that time pass. A fine procession of sharply-defined spots lay across the solar disc, and were swallowed up one by one by the invading darkness. The air, which had been intensely hot, grew chill, the weird sense of approaching disaster which always accompanies an eclipse oppressed the nerves, and then, with what seemed a sudden rush, the shadow fell.

I was watching the eclipse through a binocular, one lens of which was fitted with an eyepiece prism. As totality approached the burning spectrum at the sun became crowned with dark semicircles—the Fraunhofer lines. These grew finer and sharper, and then suddenly turned to bright flame at either end of the semicircles. The continuous spectrum narrowed, the bright arch grew with startling swiftness, a long constellation of glittering points sparkled out for a fraction of a second, and totality had begun. 'Go!' I cried. The signal clock was started, and its clear beat rang out, emphasized at every tenth second by the

* A cablegram to the London *Times.*

sharp ting of its bell, and the warning voice of the timekeeper called, 'One hundred,' 'Ninety,' 'Eighty,' according to the number of seconds still left us.

Just behind me Captain Molesworth and Mrs. Maunder, at an equatorial with two cameras, were changing plates with the confidence and precision begotten of much practice. With each camera six plates were to be exposed, and all went without a hitch, but, just as the word came for the sixth exposure, with a sudden rush an immense flood of sunlight poured forth. The eclipse had been four seconds short of the time we had expected. Meantime Mr. Thwaites had secured three photographs and Lieutenant Morris exposed several plates in small cameras. Further east Mr. Evershed, with a threefold arrangement of spectroscopes, exposed plates to catch the spectrum of the corona, and especially of the flash. Between our other occupations we looked up at the magnificent spectacle before us. The darkness did not equal the eclipses of 1886 or 1896, but the corona stood out in the sky as a vast silver star, brighter and more extended than when I saw it eleven years before. Two fine leaf-shaped extensions stretched out almost horizontally east and west, whilst nearly, but not quite, on the sun's equator, directed southwest, was the greatest ray of all, two millions of miles in length almost, pointing to where one celestial brilliant glittered several degrees away.

I had hoped to ascertain the distribution of the element coronium in the corona, but the green line, which for us composes its spectrum, was very faint, and was not seen at all on the eastern side of the sun. On the west it was traced to about 5′ in height. Whilst telegraphing we learn that Professor Naegamvalla secured forty photographs at Jewar, completing his program.

E. W. MAUNDER.

AMERICAN MATHEMATICAL SOCIETY.

A REGULAR meeting of the American Mathematical Society will be held on Saturday, February 26th, in Room 301 of the Physics Building of Columbia University, New York City. The two sessions will begin at 10:30 a. m. and 2:30 p. m., and the Council will meet at 2 p. m. From all indications this meeting promises to rival in interest the recent very successful annual meeting of the Society. The following papers have thus far been entered for presentation:

1. PROFESSOR MAXIME BÔCHER: 'The theorems of oscillation of Sturm and Klein.'

2. DR. J. W. DAVIS: 'Behavior at laboratory temperatures of gas and vapor generating globes in celestial spaces.'

3. MR. P. R. HEYL: 'The measure of the bluntness of the regular figures in four dimensional space.'

4. DR. J. I. HUTCHINSON: 'Note on the tetrahedroid.'

5. DR. E. O. LOVETT: 'On the symmetry of algebraic surfaces.'

6. DR. G. A. MILLER: 'A generalization of Sylow's theorem.'

7. PROFESSOR W. F. OSGOOD: 'A new proof of the existence of a solution of the differential equation $dy/dx = f(x, y)$, the Cauchy-Lipschitz condition not being imposed.'

8. PROFESSOR JAMES PIERPONT: 'The Early History of the Galoisian theory of equations.'

9. MR. PAUL SAUREL: 'Note on integrating factors.'

10. M. JAMES MACLAY: 'Certain double minimal surfaces.'

11. PROFESSOR H. S. WHITE: 'Inflexional Lines, Triplets and Triangles Associated with the Plane Cubic Curve.'

The January number of the *Bulletin* (Vol. VII., No. 4) contains the following papers: 'On the Commutator Groups,' by Dr. G. A. Miller; 'On the Limit of Transitivity of the Multiply Transitive Substitution Groups that do not contain the Alternating Group,' by Dr. G. A. Miller; 'Geometry of Some Differential Expressions in Hexaspherical Coordinates,' by Dr. Virgil Snyder; a review of Lie's Differential Equations, by Dr. Edgar Odell Lovett; a notice of Beman and Smith's translation of Klein's Vorträge über ausgewählte Fragen der Elementargeometrie; 'Notes;' and 'New Publications.'

The February *Bulletin* (Vol. VII., No. 5) is a 72-page number. It contains an account of the recent annual meeting of the Society, by the Secretary; an account of the Evanston meeting of the Chicago Section, by Professor T. F. Holgate, Secretary of the Section; the presidential address, 'The Philosophy of Hyperspace,' de-

livered at the annual meeting, by Professor Simon Newcomb; 'Orthogonal Group in a Galois Field,' by Dr. L. E. Dickson; a valuable review of Weber's Algebra, by Professor James Pierpont; 'Shorter Notices; 'Notes;' and 'New Publications.'

GENERAL.

THE Romanes lecture of Oxford University will be delivered by Sir Archibald Geikie in the Sheldonian Theatre on June 1st, on 'Types of Scenery and their Influence on Literature.'

MR. F. W. DYSON, of the Royal Observatory, Greenwich, London, writes to the London *Times* that the photographs of the solar eclipse taken by the Astronomer Royal, Professor Turner, Captain Hills, Mr. Newall and Dr. Copeland have all been developed and that the results are excellent. Captain Hills has succeeded in photographing the spectrum of the reversing layer, and Professor Turner has obtained marked results as to the amount of polarization of the corona.

PROFESSOR HITZIG, of Halle, has been elected an honorary member of the London Neurological Society, in the room of the late Professor du Bois-Reymond.

IT is reported in *Nature* that, after sixteen years as professor of geography at the Royal University of Turin, Professor Guido Cora has resigned his charge, in order to devote himself entirely to scientific researches in geography and related sciences. He has transferred his residence (and the direction of his periodical *Cosmos*) to Rome, Via Goito, 2.

THE physico-mathematical section of the Berlin Academy of Sciences has appropriated 700 Marks to Professor Fr. Dahl, of Kiel, for the arrangement of the zoological material collected by him in Ralûm; 500 Marks to Dr. Philipp Fauth, of Landstuhl, for the publication of drawings of the planets Jupiter and Mars, and 1,200 Marks to Dr. K. Holtermann, of Berlin, for the publication of a work on the fungi of the East Indies.

PROFESSOR EDMUND J. JAMES, of the University of Chicago, has been nominated by the Bureau of Education to represent the United States at the International Congress of Commercial Instruction, to be held at Antwerp next April.

IT is proposed to hold an International Industrial and Commercial Congress in Brazil, from May to October, 1899.

A CONFERENCE of representatives of the National and State Boards of Health to consider questions of general sanitation will probably be arranged in connection with the International Health Exposition, to be held at the Grand Palace, New York City, from April 25th to May 21st.

IT has been decided to hold at Earl's-court, London, from May to October next, a universal exhibition intended to illustrate the inventions, industries, manufactures and applied arts of to-day. An endeavor will be made to render it international in its scope, and sections have been devoted to France, Germany, Russia, Austria-Hungary, Switzerland, Turkey, Bosnia and the United States. The exhibition will be the fourth of the series held at Earl's-court, under the management of the London Exhibitions (Limited).

THE Council of the Sanitary Institute of Great Britain has accepted an invitation from the Lord Mayor and City Council of Birmingham to hold its seventeenth congress and exhibition in that city in September next.

AN exhibition of the collections of the Jesup North Pacific expedition, made during the summer and autumn of 1897, will be opened in the American Museum of Natural History on February 15th. A lecture on the general results of the expedition will be given, at 3 p. m., in the museum.

MR. H. S. H. CAVENDISH, already known for his explorations in Somaliland, is about to start with a caravan of four hundred natives to investigate the country west and northwest of Lake Rudolf, in equatorial Africa.

MR. G. B. SUTTON, of Newark Valley, has presented to Cornell University a collection of the woodpeckers of North America, together with an oil painting representing a forest scene. The woodpeckers, representing 24 species and 11 sub-species, are mounted in natural attitudes upon an artificial beech stump, about 3.3 meters

in height, and are so arranged that they can all be seen at a glance. Mr. Sutton purposes giving to the University a group of nocturnal animals mounted in a similar manner.

A SERIES of specimens of rare coal taken from mines in Missouri, Arkansas and Texas, and a collection of petroleum, petroliferous rocks and petroleum shales from India have been presented to the museum of economic geology of New York University.

GENERAL LEW WALLACE has announced that at his death the city of Crawfordsville, Ind., will come into possession of his study, which has just been completed at a cost of $40,000. The building is to be used as a public library. A collection of rare books will be included in the gift.

WE take the following items from *Natural Science*: The association française de botanique has acquired as its organ *Le monde des plantes*, for many years edited by Mr. Léveillé, of Mans (56 Rue de Flore). The Association is intended to take the place of the Société française de botanique, which ceased to exist in 1895. It is intended to form a central herbarium and library, free to members, and to undertake the exchange and determination of specimens. The State Museum, Vienna, received the following collections during 1896: Eppelsheim collection of Coleoptera, including more than 2,000 species or 26,000 specimens of Staphylinidæ; the Gustav Mayr collection of Hemiptera, including 1,350 species or 5,500 specimens; the Bergenstamm collection of Diptera, including 3,000 species or 45,000 specimens; the Steindachner collection of fish, chiefly from the Red Sea, 3,400 specimens representing 702 species. The collection of geological photographs in this Museum then numbered 1,892, while the ethnographic photographs were 5,477. The Colonial Museum at Marseilles, opened in 1893, is remarkable for its valuable collection of tropical vegetable products. These are studied and analyzed under the direction of Mr. Heckel in the Museum laboratory. Among recent acquisitions may be mentioned Dr. Buisson's collection of the mollusca of Tahiti, botanical collections from New Caledonia, presented by Messrs. Heckel and Jeanneney and Col. Pelletier, and from the Antiles by R. P. Düss.

THE January number of the *American Naturalist* has just been issued by Ginn & Company, being the first number to be issued under their imprint. The appearance of the journal is greatly improved, a heavy glazed paper being used, with wide margins and new type. The issue of the first number of the thirty-second volume, the first entire volume under the new management, is made the occasion of an editorial on the aim of the *American Naturalist*, the province of the journal being defined as follows: "May it not be possible to regard the earth and its inhabitants as a unit? Then the problem would be to describe the various parts of this unit and to explain their relations to one another. While the solution of this problem is too vast an undertaking for any one man or any generation of men, may it not be legitimate to adopt it as the final purpose of a journal which is intended to represent the great body of naturalists in this country? It seems to us that there is a legitimate ideal of attainment and one which, if kept steadily in view by editors and contributors, will afford that unity of purpose which is essential to success."

WE have received the first two numbers of the *Journal of Applied Microscopy*, edited by Mr. L. B. Elliott, and issued from the publication department of the Bausch & Lomb Optical Company, Rochester, N. Y. The first numbers contain contributions from several leading American zoologists, and the coöperation of about a hundred men of science, who use the microscope as an instrument, has been promised. In the introductory editorial the scope of the journal is defined as follows: "It will be a progressive record of new apparatus of every kind bearing on the operations leading up to and including the use of the microscope, improvements in apparatus and new applications of apparatus already existing, methods of working, new and useful formulæ, discussion of matters relating to the above subjects, digests of similar matter appearing in foreign journals, and news and notes about institutions and men here and abroad."

THE Duquesne Steel Works of the Carnegie

Steel Company have in a single day produced 204 'heats' in twenty-four hours, and 1,928 tons of ingol-steel in the converting and 1,700 tons in the finishing mill. This is said to exceed anything reported previously in the United States and to be vastly in excess of anything known in Europe.

ON motion of Senator Cantor, the Assembly resolution calling on the Representatives of New York State in Congress to secure the establishment of a national park on the Palisades of the Hudson was taken from the table by the Senate at Albany on February 9th and adopted. A bill designed to protect the Palisades from further injury was introduced into the House of Assembly at Trenton, N. J., on February 8th, by Mr. Marnell, the provisions of which are as follows: "Every person or corporation which shall, within a distance of 2,000 feet from any navigable river forming the boundary line of this State, explode or cause to be exploded, for the purpose of blasting, breaking or loosening rock, any high explosive, shall be guilty of a misdemeanor, and on conviction thereof shall be punished by imprisonment not exceeding one year, or by a fine not exceeding $1,000, or both."

GOVERNOR BLACK, of New York State, advocates the passing of a bill that would lease to Cornell University for twenty-five years about twenty thousand acres of State land outside of the limits of the Forest Preserve. By the aid of an annual appropriation, which this year may be $25,000, the University authorities would be enabled to engage in forest culture. The best methods of forest preservation and cultivation in France and Germany would be followed on this tract of twenty-five thousand acres. The trees would be trimmed at the proper time; 'ripe' trees would be cut down and sold, and young trees would be planted. The aim would be to make the tract a paying investment for the State. If this model forestry park should be a successful experiment, the same method of management could be applied to the eight hundred thousand acres of forest land the State now owns in the Adirondacks.

Natural Science asks: "How many copies of a printed book need be issued to constitute a publication? This question seems to be raised as a side issue in a paper by Mr. Davies Sherborn on Thomas Martyn's 'Psyche,' in the January number of the *Annals and Magazine of Natural History*. Mr. Sherborn states that only ten copies of the book were issued; and the names of the species were, with six exceptions, written in ink either below the figures themselves or on fly leaves. The fact that the names were not printed is sufficient for Mr. Sherborn to stamp them as manuscript, despite the fact that they have been used by entomologists. We wonder what entomologists will say. One interesting fact in connection with the matter is that the author of this paper had actually three out of the ten copies, side by side for comparison, and has been able to trace five out of the original ten. Mr. Sherborn does not mention the copy of Part I. in the Hope collection at Oxford, but that evidently falls under his 'specimen' copies, of which it is likely others may turn up. Now let us suppose this to be a printed book. What happens? Four entire copies of the original ten are in England, one is in Holland, the rest are unknown. What possible chance has an American or an Australian of seeing such a book? Without seeing it his work must be imperfect. We offer no decision of the difficulty ourselves, but think the point sufficiently interesting to call attention to it."

THE *Auk* for January contains, as frontispiece, the portrait of the late Charles E. Bendire, accompanying a memorial article by Dr. J. C. Merrill, presented at the 15th Congress of the American Ornithologists' Union.

DR. T. J. ROTHROCK, State Forestry Commissioner of Pennsylvania, states in his report to the Department of Agriculture, quoted from advance sheets from the *Public Ledger*, that while the rainfall last year was greater than in previous years the streams seem to have been lower. Dr. Rothrock considers that there can be no doubt but that in the periods of annual minimum water flow our rivers are delivering less water each year. Thus the most reliable statistics available show that in periods of least annual flow the water sent down by the Schuylkill river at Philadelphia in 1895 was only 39 per cent. of the amount available in 1816.

Three explanations may be offered: First, that we are passing through a period of less rainfall than formerly. Second, that the disastrous change is due to disturbing the former balance of natural conditions by removal of the forests. Third, that much of this missing water has been used before it reaches the point or points at which the estimates were made. It is on the second of these explanations that Dr. Rothrock lays the most weight.

Miss Ormerod, of Torrington-house, St. Albans, has published her annual letter on insect pests in Great Britain. She mentions, according to the London *Times*, the damage done to grass and corn crops by wireworms, leather-jackets, chafer-grubs, and the caterpillars of the small swift moth. Hessian fly and corn sawfly were reported locally. Insect attacks upon orchard and bush fruits are becoming more numerous. The codlin moth, the apple sucker and the mussel scale were all troublesome, and there is at least a probability that the American 'apple grub' has obtained a foothold in English orchards. The wood of plum trees was tunnelled by shot-borer beetles, and the foliage of cherry and pear trees was ravaged by the small slug-like larva of the pear sawfly. The more conspicuous pests of timber trees is the 'timber-man' beetle and the elm-bark beetle. A matter of special interest is the risk incurred by a large importing country like England of bringing within its borders exotic pests which happen to infest produce grown abroad. Several illustrations of this are incidently given by Miss Ormerod. Thus, the larva of the Angoumois moth was brought to England in barley imported from North Africa. The Mediterranean mill moth was found in flour shipped from an Adriatic port, and this exceedingly troublesome pest is undoubtedly establishing itself—it is to be feared permanently—in flour mills and flour stores. Locusts are present in considerable numbers in Lucerne hay from Argentina, and a case is mentioned in which three horses fed on such hay fell ill, but recovered when the hay was discontinued. The 'German cockroach' is making an apparently successful invasion of English kitchens. It is much smaller than the common cockroach, is yellowish or brownish in color, and striped with dark brown.

UNIVERSITY AND EDUCATIONAL NEWS.

The report of President Eliot, of Harvard University, with the appended documents, makes a volume of some 376 pages. President Eliot lays special stress on the desirability of granting degrees in the middle as well as at the close of each academic year, urging that this would be of great importance to some classes of students. The votes of the corporation formally inviting the Massachusetts Institute of Technology to affiliate with Harvard University are given, readiness being expressed to make such modifications in the technical departments of Harvard University as may be desirable. It is suggested as of pressing importance that the medical school be removed to a new site, and that a hospital be erected as an adjunct to it. The income of the University apart from new endowments was $1,327,360.57, while the payments were $1,228,941.50.

The regents of the University of California have decided to establish a college of commerce as one of the departments at the University. President Kellogg is directed to make application to the President of the United States that an engineer officer of the United States Navy be detailed, in accordance with the Act of Congress approved in 1879, to act as instructor in the college.

At the recent meeting of the Board of Trustees of the University of Tennessee it was decided to erect a new building for the department of mechanics and two new dormitories. It was also determined to establish, in the near future, a separate school of economics.

By the death of Miss Sara M. Fletcher, of Woodstock, Vt., $6,000 is left to Dartmouth College, as provided by the late Richard Fletcher, of Boston.

The sum collected for Vassar College through the efforts of its alumnæ now amounts to $90,000, of which $50,000 will be devoted to the establishment of the Maria Mitchell chair of astronomy.

Dr. George Santayana, instructor in philosophy at Harvard University, has been appointed to an assistant professorship.

The name of the Hon. Carroll D. Wright has been added to the faculty of Dartmouth

College as lecturer on the application of statistics to social and political science; George P. McKee has been appointed instructor in physics.

Professor Charles R. Richards, director of the manual training department of the Pratt Institute, Brooklyn, has been appointed to the chair of manual training in the Teachers' College, Columbia University.

At the University of Cambridge, Mr. F. C. Kempson and Mr. R. H. Biffen, of Gonville and Caius College, have been appointed demonstrators of anatomy and botany respectively.

DISCUSSION AND CORRESPONDENCE.

WEATHER HARMONICS.

The study of weather periodicity has, from the beginning of meteorology, attracted, more or less, the time and attention of students. Yet, so baffling and uncertain are the results so far produced that many have been led into the scepticism voiced by a recent writer, who remarks, 'There is, apparently, no periodicity in the recurrence of weather.' It seems to me, however, that this attitude is the same as that of a student who visited the track of a tornado, expecting to find the trees and other débris lying in perfect circles, but on finding the fallen trees lying over each other pointing in different directions, and other débris in tangled confusion, came back and announced his conviction that no whirl existed in the tornado funnel. In other words, my study of the subject for many years convinces me that it is the complexity of the data, not the absence of the phenomenon, which has induced this scepticism in regard to weather periodicity.

I am led to the conclusion, which is extremely important if true, that one of the complexities which has helped to obscure weather periodicity is the existence of what may, perhaps, be called weather harmonics, on account of the resemblance to harmonics in sound—that is, the existence of other periods related to the primary as 2, 3, 4, etc. In what follows I shall briefly outline the evidence on which this conclusion is based.

For the first examples I take the best known and only generally accepted cycles, the annual and daily periods. The first harmonic periods I wish to point out are multiples of a year, namely, two, three, four and eight years in length, all of which are continuously acting, but now and then one becomes predominant, so that it may be selected for illustration.

Thus, over the interior of the United States there were for many years very marked oscillations of pressure, temperature and humidity covering a period of about two years. These were discussed in the *American Meteorological Journal*, Vol. I., pp. 130 and 528. The data appeared at first to indicate a period about a month longer than two years, but later investigation indicates that it is more exactly two years. Three and four-year multiples have not been marked in the United States, but an eight-year period has been well marked. Thus the Chief of the Weather Bureau gives, in his latest report (1897, p. 23), the years of widespread drought in the United States during the last forty years as follows, 1860, 1863, 1870-71, 1881, 1887 and 1894-95. An eight-year series, running as follows, 1863, 1871, 1879, 1887 and 1895, takes in four out of six droughts. This seems to have been acting with the eleven-year or sun-spot period, the maxima of which occurred about 1860, 1870, 1883 and 1894, and are apparently connected with droughts in the United States. In the British Isles during the last 50 years three, four and eight-year periods appear to have been equally active, hence no simple rhythm can be selected for illustration. But I desire to call attention to one striking fact. It is well known that harmonic sound waves, after a certain number of oscillations, occur with their like phases together, and form beats, and it might be expected that harmonic weather periods, if they exist, would likewise form beats. Since 24 is a common multiple of 2, 3, 4 and 8, extremes of weather would be expected to be separated by such an interval. Now, it is a curious fact that the curves published by A. B. MacDowall, showing the number of frost days at Greenwich, show very marked extremes at this interval. For example, the greatest number of frost days were in 1855 and 1879, 24 years apart, while the least number were in 1872, 1884 and 1896, separated by intervals of 12 and 24 years. (See *Meteorological Zeitschrift*, 1897, p. 384.)

I have reason to believe there are also periods

of a-half, a-third, etc., years, but these appear to be less marked than the multiples of years.

There are also weather periods which are even multiples of days. The most marked of these are 3, 4, 5 and 8 days. On account of limited space I can only illustrate one period, and because of accessible data I have selected the 4-day period. Taking the observations of temperature at 8 a. m. and 8 p. m., made at the Blue Hill Meteorological Observatory during 1895, and obtaining the departures from the normals, the residuals were classified into 4-day periods. The means of each six periods were then obtained and are given in the following table:

1895.	MEAN DEPARTURES IN DEGREES FAHRENHEIT.							
Jan. 20–Feb. 12	−3	−3	−1	+2	+3	+3	+2	−1
Feb. 13–Mar. 8	+2	+2	0	−1	−2	−1	+1	+2
Mar. 9–April 1	+2	+2	+1	−1	−1	−1	−1	+1
Apr. 2–April 25	+2	+1	−2	−2	−1	+1	+2	+3
Apr. 26–May 29	+3	+1	−2	−3	−3	−1	+3	+4
May 30–June 12	+2	+3	+2	+1	−1	−2	−2	−1
June 13–July 6	0	+1	0	0	0	−1	0	+1
July 7–July 30	0	+1	0	+1	+1	+1	0	0
July 31–Aug. 23	0	0	−1	0	0	−1	0	+1
Aug. 24–Sept. 16	+3	+1	0	−2	−2	−1	+1	+2
Sept. 17–Oct. 10	+2	+3	+2	0	−2	−2	−1	0
Oct. 11–Nov. 3	+2	+3	+2	0	−1	−2	−2	0
Nov. 4–Nov. 27	+2	+1	−1	−2	−1	+1	+2	+2
Nov. 28–Dec. 21	+1	+3	+2	+1	−1	−2	−2	−1

This table shows that throughout the year plus departures are found on the first day of the period, with but one exception; while on the third day, out of twenty-eight recorded means, twenty-one were minus departures. This period, has continued equally well marked and mainly with the same phase during the last three years. The range of temperature in the period is about four degrees, while the mean daily range of temperature from hourly records at Blue Hill is about 10° F. Under certain conditions there is a semi-diurnal oscillation in the temperature (Annals of Harvard College Observatory, Vol. 20, p. 123).

One further illustration will be sufficient, perhaps, to show the universality of the harmonic law. For this I have selected the 22-year or double-sunspot period. Mr. R. C. Mossmann gives a table in the Transactions of the Royal Society of Edinburgh, Vol. XXXIX., p. 187, showing for Edinburgh the departures of temperature from normal, from 1764 to 1896, smoothed by continuous five-year groups. These means show little or no trace of an eleven-year period, but in Mr. Mossmann's plotted curve of the annual means show six distinct waves of a length of about 22 years. Thus the minima of the waves occurred as follows:

Observed Minima	1772	1784	1815	1838	1860	1879
22-year cycle	1771	1793	1815	1837	1859	1881

With the exception of 1784 these dates differ but little from that of an exact 22-year cycle, and approximate very closely the dates of minimum in the same cycle in New England, in Iceland and in Paris (*Nature*, Vol. 51, p. 436). The annual averages in Mr. Mossmann's table were classified into six periods of 22 years, beginning with 1766, and averages were obtained from each year of the cycle. These, in tenths of a degree Fahr., are as follows:

Year of cycle	1	2	3	4	5	6	7	8	9	10	11
Means	+2	+3	+1	−1	−3	−6	−6	−5	−3	−1	+1
Mean error ±	5	7	7	6	5	4	5	4	5	3	3
Year of cycle	12	13	14	15	16	17	18	19	20	21	22
Means	+2	+3	+7	+5	+6	+6	+2	+1	+0	+1	+1
Mean error ±	3	3	4	2	1	2	2	4	3	5	3

These means show a well marked period, and at the epochs of maximum and minimum the means are considerably larger than their mean errors. At the time of maximum, between the 14th and 17th year of the period, the means are nearly three times as large as their mean errors, an unusually favorable showing in the case of a meteorological cycle. Dr. Schreiber's curves of the eleven-year period in rainfall, published in the Abhandlung des Konigl. sachs. meteorologischen Institutes, Plate IV., show that the eleven-year period at Dresden and Freiberg is made up of two primary waves of nearly equal magnitude and two secondary waves midway between the primary.

The harmonics in the case of periods of other lengths were pointed out in the *American Journal of Science*, Vol. XLVIII., p. 231. The application of these weather cycles to forecasting is interfered with: (1) by the multiplicity of the cycles and their independent variations in amplitude according to some unknown law; (2) the oscillations of the cycles (including the annual and daily cycles) simultaneously in different phases in different parts of the world (see *American Meteorological Journal*, Vol. I., p. 528); (3) the sudden inversion of the phase

of the cycle from time to time at any one point on the earth's surface. Number (3) appears to be true for every cycle except the annual and diurnal cycles, and is the most difficult and confusing condition that confronts the believer in weather cyles. The formula

$$\sum \frac{\cos nx}{n^2-8^2}$$

is a mathematical expression of the sudden inversion of phase which may take place in harmonic curves, as is beautifully shown by Professor Michelson's harmonic analyzer. Whether this, however, has any relation to weather curves is uncertain.

I feel strongly that the difficulties will in time be solved, and that forecasting by means of weather cycles will supplant largely, if not entirely, all other forms of weather forecasting.

H. HELM CLAYTON.

BLUE HILL METEOROLOGICAL OBSERVATORY,
HYDE PARK, MASS., February 8, 1898.

SCIENTIFIC LITERATURE.

The Ruins and Excavations of Ancient Rome. A Companion Book for Students and Travelers. By RODOLFO LANCIANI. Boston and New York, Houghton, Mifflin & Co. 1897. Small 8vo. Pp. xxiv+619.

This book will be a godsend to the more intelligent class of English-speaking travelers, who are not obliged to limit themselves to a very short stay in Rome. Few, indeed, are the persons who have not felt somewhat bewildered when they have been called upon to map out their time for a winter in the Eternal City so as to use it to the best purpose.

The ordinary guidebook, no matter how good it may be, is not enough ; Middleton's 'Ancient Rome,' which is in many ways almost indispensable, is written largely from an architect's point of view ; the various German works are for the most part intended more for professional students of antiquity, and Professor Lanciani's other two books, 'Ancient Rome in the Light of Recent Discoveries' and 'Pagan and Christian Rome,' are of too popular a character to be very useful, if a person wishes to undertake a serious, albeit a not strictly professional, study of the ruins of the city. There was, therefore, need for just such a book, which should cover substantially the whole field and which should include the most recent results of Roman topographical investigation, as the one before us. Its usefulness will, however, by no means be confined to intelligent travelers, for, to quote from the preface, 'students wishing to attain to a higher degree of efficiency in this branch of Roman archæology (viz., topography) will find copious references to the standard publications on each subject or part of a subject.' Indeed, the skill with which Professor Lanciani has constantly kept in mind the needs of these two classes of readers, without thereby spoiling the unity of his book or making it unfit for either class, is worthy of high praise. The enormous mass of material which must be handled in any treatment of Roman topography has been arranged and presented with simplicity and skill ; questions in dispute have been indicated without lengthy discussion, and thus the dryness so characteristic of works in which the statement of a very large number of facts is necessary has been in a great measure avoided.

In Book I. of his work, which contains 'general information,' Professor Lanciani has gathered together a large amount of material that is not easily accessible. The geological formations about the city, the climatic conditions, the quarries, the bricks and the Tiber are discussed. The walls in different periods, the bridges, the aqueducts, the *cloacæ*, the regions of Augustus and the maps of the time of Severus —what might, in fact, be termed the anatomy of the city—are also treated here. Some interesting statistics, too, in regard to population and the amount of the water supply have been included. Books II. and III. are concerned with the very heart of the city—the Palatine Hill and the Sacra Via from Coliseum to Capitol— and here is included also the discussion of the Forum Romanum and of the adjoining *fora* of imperial times. In book IV. the rest of the city is described according to the Augustan Regions and there is a brief concluding chapter on the 'general aspect of the city.' This is followed by an appendix containing lists of the Emperors, Popes and artists and useful information touching chronology, weights and

measures, etc. There are also two classified indexes, but no general one.

No attempt can be made here to review with any real thoroughness this important and interesting contribution to the ever fascinating study of Rome. One or two special points of excellence, however, may be noted and a few rather trivial defects pointed out which might easily be remedied in another edition.

The student will be glad to have in a work so readily accessible as this book is the discussion of the earliest settlement on the Palatine in the light of the excavations at Antemnæ and at Castellazzo di Fontanellato. No doubt deeper excavations are necessary before any clear idea of the pre-historic settlement in Rome can be gained; yet, with a knowledge of the lay of the land and of the settlements which must have had many points in common with that on the banks of the Tiber, the beginnings of the city are removed from the domain of pure speculation. It is pleasant, too, to note that a rational explanation of the dark rooms in Caligula's palace may now be read by the visitor to the Palatine, and that he will no longer be asked to believe that the beautiful decorations were never seen except by artificial light. It is, however, to the account of the Pantheon, the most impressive structure in our heritage from ancient Rome, that the average reader will turn with keenest interest. Doubtless many knotty questions about the building have not been and perhaps never will be solved, but the most recent and very important studies of it have developed the cardinal fact that the present structure dates from Hadrian and is not Agrippa's at all. Agrippa's structure was probably of a different shape and faced south instead of north. It appears to have looked out on a circular open space which was paved and which was enclosed by a wall that is concentric with the foundations of Hadrian's Pantheon. Unfortunately, it is still a mystery what the relation of the building to the thermæ was. Lanciani's account of this complicated architectural problem is a model of clear, simple statement, quite free from the vice of claiming results which it is not possible to prove.

It would be easy, if it were worth while, to extend in detail an enumeration of the many excellent features of this handbook, but it is not so easy to discover its defects, which at best are insignificant. In the first place there should be a good map of modern Rome in the book. The lack of this is occasionally an annoying omission, as an attempt to follow out carefully the account of the bridges, pp. 16 ff., will show. A new general map of the Palatine would be an improvement. Many students of Greek sculpture will quarrel with the positive attribution of the 'Venus Genetrix,' p. 301, to Arcesilaus, and they will miss, p. 415, a reference to the publication in the *Antike Denkmäler* of the remarkable relief on the marble throne of the 'Venus Sallustiana.' Very welcome, however, is the publication of the beautiful Greek head on p. 177.

The English of the book is simple and clear, with almost no traces of foreign influence. On pp. 62 and 104 'designs' and 'designed' are not used in accordance with our idiom. 'Hexedra,' p. 176, can hardly be justified, and the spelling 'Polykletos,' p. 215, is rather a flagrant example of the confusion we have fallen into in the transliteration of classic names. The German 'Poebene,' p. 115, even in quotation marks, is scarcely better than Valley of the Po or Po Valley, and it is questionable whether 'unities' (*oncie*) of water, p. 184, will be readily understood.

The publisher's work has been well done, though the volume is heavier than one could wish. There is a trifling misprint in 'tribute (sic) of the plebs,' on p. 117.

J. R. Wheeler.

Les Cécidomyies des céréales et leurs parasites. By Dr. Paul Marchal. Annales de la Société Entomologique de France, Volume LXVI. 1897. Pp. 1–105; Plates I.–VIII.

This paper, which has just come to hand, is, taking it all in all, the most important contribution to a knowledge of the Hessian fly in Europe which has ever been published. It contains also studies of a very great biologic interest, especially with regard to the larval development of certain of the parasites of the larva of the Hessian fly, and it is especially in relation to these observations that this review is submitted. Dr. Marchal has studied carefully the life history of *Cecidomyia destructor* in

France, his attention having been called to the species by extensive damage in the Vendée during 1894. He shows that, although previous writers in many countries have given three as the maximum number of annual generations, in France there may be developed, under the most favorable circumstances, six such annual generations. The most part of these, however, are partial, and the most incomplete are the third, fourth and sixth. He has shown that there is a considerable retardation of development where humidity is lacking, dryness having been responsible for a retardation of two months. An interesting section on natural selection concludes with the statement that, far from being adapted to climatic conditions by natural selection, the species is perpetuated in spite of obstacles placed in its way by exterior conditions, and that it overcomes these obstacles only by its fecundity and by the great variability of its biologic cycle. Careful studies are given of other species of Cecidomyiidæ affecting grasses and grains in Europe and elsewhere, and especially of *Cecidomyia avenæ*, a closely allied form which the author has differentiated from the Hessian fly.

The observations made on the biology of parasitic insects are nothing less than remarkable. The larval development of internal feeding insect parasites is, of course, very difficult to observe. Few observations of value are recorded. The well known studies of Ganin on certain Platygasters were the earliest. The studies by Bugnion on the structure and life history of *Encyrtus fuscicollis*, an internal parasite of the European *Hyponomeuta cognatella*, are the only ones of importance which have appeared since Ganin. All of the species of the genus *Trichacis* are parasitic within the bodies of Cecidomyiid larvæ, and the genus is closely related to the form studied by Ganin. According to Marchal the first larval form of *T. remulus* corresponds to the type of the curious cyclops-like larvæ studied by Ganin, and which certain authors regard as an adaptive form, while others see in it an ancestral form. The post-embryonic development, according to Marchal, is as follows:

When they are young and motionless, and have not issued from the cysts which contain them, these larvæ are always lodged in the interior of the nervous system of the host larva, and there they bring about alterations and proliferations of a very curious character. The most frequent is at the posterior extremity of the nerve chain, where the cyst of the parasite is formed. This extremity spreads out into an enormous bouquet of club-shaped giant cells, which alone fills the larger part of the body cavity of the host. The larva of the parasite is lodged in a cyst filled with liquid, the cellular structure of which, with broad, polygonal contour, seems to indicate an amniotic envelope in a condition of retrogression. All around this membrane the giant cells are grouped. These exist not only in the immediate neighborhood of the cyst, but all the surrounding region of the nerve chain seems to have undergone the same degeneration and growth of giant cells. The youngest cells are hyaline and present a fibrillous, longitudinal structure. The oldest cells are filled with fatty globules and become entirely opaque. The giant cells increase and isolate vesicles, which separate and fall into the body cavity in the form of protoplasmic spherules, which are absolutely characteristic. When one dissects a Cecidomyiid larva under the microscope he can be sure, if he sees these spherules floating in the liquid, that there are in the preparation one or more larvæ of this parasite. The localization of the larvæ of the *Trichacis* in the nerve chain or in the nerves of the larva presupposes that the parasite pierces the egg or the young larva upon the median ventral line at the time when the nervous system has not begun to branch and is concentrated in a single ventral band. The mass of giant cells accumulate in themselves evidently the nutritive material necessary to the parasite. They are a kind of internal animal gall, developed by the presence of the parasite. The *Trichacis*, in the condition of the cyclops-larva, waits in its cyst until the tissues which surround it have submitted to the transformations by which it profits later for its food; then, when the host larva, exhausted by its presence, is transformed into a sort of a sac filled with giant cells, it issues from its cyst to devour the accumulated material, which, probably, has nutritive qualities

nearly identical with those of the vitellus. After undergoing successive transformations into three larval forms the adult insect finally issues from the puparium of its host, only one adult finally making its appearance from an individual puparium, although in the cyclops stage four larvæ may be present. There seems, in this first stage, to be a physiological competition between *Trichacis* larvæ, only the oldest surviving to take on its second stage. An interesting point is that there appear to be definite molts from the first to the second and from the second to the third stage, and that the dead bodies of the cyclops larvæ which succumb do not interfere with the development of the survivor.

Careful observations have also been made with an allied parasite, *Polygnotus minutus*. The larvæ of this species, instead of being localized in the nervous system, as are those of the *Trichacis*, are found in the gastric sac, where there are found a number of 10 or 12 grouped together, developing simultaneously, and all, or nearly all, destined to reach the adult condition. The group of young larvæ forms a mass situated in the interior of the stomach. It is surrounded by a hyaline and, perhaps, adventitious membrane. Each parasitic embryo is also surrounded by a membrane of its own. The larva is elliptical, somewhat attenuated at its posterior extremity, and provided with rather well developed mandibles. They fill the gastric cavity, which is generally distended. The second and third larval forms follow. The host is almost entirely devoured and reduced to a cutaneous sac. When ready for pupation they occupy the entire body cavity of the host, the skin being distended and showing by impressions the positions occupied by the contained parasites, thus appearing full of minute cocoons.

It is strange that a field of such great biologic interest as the development of these insect parasites has been neglected to a striking extent. The difficulties which once surrounded the technique of such studies have been brushed away by the discoveries of modern morphologists, and a great field is open to the first well equipped worker who cares to enter it.

L. O. HOWARD.

L'Année psychologique, 3me Année. Publiée par M. ALFRED BINET. Paris, Alcan. 1897. Pp. 825.

The three years of this annual have now made for it an established place among psychological journals, and furnish gratifying evidence of the introduction in France of sound laboratory methods in dealing with all phases of mental activity. M. Binet has established at the Sorbonne a laboratory where the abnormal and the startling, so closely associated with French psychological research, do not constitute the main field for investigation, but where problems more nearly approaching those of most other psychological laboratories awaken chief interest and receive valuable contributions toward their solution. The present number confines its original contributions, of which a a brief analysis is given below, more strictly than before to the announcement of results of research at the Sorbonne, and gains thereby a decided advantage in reduction in size. One of the main interests of this laboratory at present is evidently the problem of the relation of blood-circulation to mental process. Its discussion occupies more than half the pages devoted to original matter. The problem is one of large importance to psychology, and it is being materially advanced, both as to method and as to established facts, by such work as is here reported. In addition to its original articles the Année contains as usual careful analyses of the psychological literature of the year (pp. 335-688), and the bibliographical index of *The Psychological Review.*

(1) *L'abstraction des émotions* (Pp. 1–9): TH. RIBOT. Abstract emotions can exist to a very limited extent. They are formed by the combination of characteristics common to various particular emotions, without losing wholly their true affective tone. Such terms as: 'spirit' of a country, of a place, of an opera, etc.; 'moral environment,' and 'moral atmosphere,' express such a condensation of emotions. Other examples are found in certain æsthetic works, especially those of the symbolists.

(2) *Les changements de forme du pouls capillaire aux différentes heures de la journée* (Pp. 10–29): BINET and COURTIER. Many variations exist in the form of the capillary pulse in dif-

ferent individuals and under different conditions. But one fact remains constant: Under the influence of a meal there occurs an acceleration of the heart, an augmentation in the amplitude of pulsation, and a lower position of the dicrotism. As the hour of the meal grows more distant the heart works more slowly, the amplitude of pulsation decreases, the dicrotism mounts toward the summit of the pulsation and tends to diminish or disappear. These phenomena are not due to the changed temperature of the hand alone, and are seen in the pulse of the wrist and of the carotids, as well as of the capillaries. They are doubtless intimately related to the sense of well-being, expansion and force which follows a moderate repast.

(3) *Les effets du travail musculaire sur la circulation capillaire* (Pp. 30–41): BINET and COURTIER. Local and fatiguing muscular exercise produces a weakening of the dicrotism, a blunting of the point of the pulsation, a tendency toward displacement of the dicrotism toward the point. General and moderate muscular exercise lowers and accentuates the dicrotism and sharpens the point of pulsation. General and fatiguing exercise weakens the dicrotism without displacing it toward the summit.

(4) *Effets du travail intellectuel sur la circulation capillaire* (Pp. 42-64): BINET and COURTIER. Short and energetic intellectual effort produces an excitation of the functions, vaso-constriction, acceleration of the heart and respiration, followed by a slight slackening of these functions; also in certain subjects, weakening of the dicrotism. Intellectual work lasting several hours with relative immobility of the body diminishes the heart's rapidity and the peripheral capillary circulation.

(5) *Influence de la vie émotionnelle sur le cœur, la respiration et la circulation capillaire* (Pp. 65–126.): BINET and COURTIER. In most persons every emotion produces a vaso-constriction, an acceleration of heart and respiration, and an increase in amplitude of the chest; and the more intense the emotion, the more marked are these effects. In a few rare cases a sensation of pain and an emotion of sadness very slightly lessened the rapidity of the heart. It is possible, as was shown by observation of one subject especially, that the form of the capillary pulse changes with the *quality* of the emotions—a fact which may some time make possible a classification of emotions according to their physiological effects upon the form of the pulse.

(6) *Influence du travail intellectuel, des émotions et du travail physique sur la pression du sang* (Pp. 127–183): BINET and VASCHIDE. An improved form of the sphygmomanometer of Mosso was used to indicate the relative, though it did not give the absolute, measure of the blood pressure. This was found to increase under the influence of all the excitations mentioned above. The most intense effect was produced by physical work; spontaneous emotions came next, and the least intense effect was given by intellectual work. As the capillary pulse seemed to be intimately related to the quality of emotions, so the pressure of blood may prove to furnish a measure of the quantity (or intensity) of mental phenomena.

(7) *Enquête sur les premiers souvenirs de l'enfance* (Pp. 184-198): V. and C. HENRI. A series of questions was published in various reviews in 1895, to which 123 answers have been received. The first memory may be of an event occurring as early as the age of six months, or as late as eight years; the large majority correspond to the age of two to four. Other interesting details are given, and a further pursuit of the enquiry is promised.

(8) *Sur la localization des souvenirs. La localization dans les expériences sur la mémoire immédiate des mots* (Pp. 199–224): N. VASCHIDE. Series of words were read, 8 to 20 in number, and the subject was required to indicate the position of each word in the series. The main results were these: (1) There is not one single method of localization, but several differing greatly from one another. (2) These methods do not all of them depend essentially upon the memory; some depend on reasoning; and in many cases, where the localization is made by memory, reasoning directs or controls the task. (3) The localization is not made always, as has been supposed, by association, or, in other words, by reference to certain 'points de repère.' That is only one form, the mediate form. Some localizations are direct, immediate.

(9) *Nouvelles recherches sur la localization des sensations tactiles. L' expérience d' Aristote* (Pp. 225–231): V. Henri. If two fingers are crossed and their ends touched by the two points of a compass, then the further removed from one another the two points actually touched, the nearer they will seem; and the point actually to the left will seem to the subject to be toward the right, and *vice versa.* If in this position of the fingers a single point of one finger be touched, it will be mistaken for the corresponding point of the other finger. Previous theories of tactile localization cannot explain these facts, and a discussion of their explanation is reserved for a later paper.

(10) *Étude sur le travail psychique et physique* (Pp. 232–278): V. Henri. This paper is a contribution to the study of 'individual psychology.' Two factors enter into all work, whether mental or physical: *voluntary effort*, for the measure of which no sufficient test yet exists; and *attention.* The following tests are suggested for the study of the constancy and variations of the latter: (1) a series of discriminative reactions; (2) mental calculations, multiplication being preferable to addition; (3) writing to dictation as rapidly as possible; (4) learning by heart series of twelve numerals, and noting the number of repetitions necessary, and the number learned after each five minutes. Each of these tests shows results differing greatly with different individuals. Beside these general factors other special factors enter into particular kinds of work. Physical work depends especially upon *motor ability* or *skill*, for whose testing no thoroughly good test has been suggested, and *muscular power*, best studied by determining the manner in which an individual becomes fatigued. For this purpose Kräpelin's modification of Mosso's ergograph is well suited. For methods of determining the factors entering into mental work Henri refers to the article published by him and Binet in the previous review. He further shows the importance to pedagogy of these researches on mental and physical work, and finally presents, with some detail, the results attained by previous investigators in this field, and gives a bibliography of the subject.

(11) *Réflexions sur le paradoxe de Diderot* (Pp. 279–295): A. Binet. Diderot claimed that a great actor does not experience the emotions that he depicts, and supported this contention by several arguments. Binet questioned nine actors in regard to this, and all replied unanimously that an actor always feels more or less the emotions of his character. Binet analyzes this artistic emotion and also the complex state of consciousness, at once emotional and critical, of both actor and spectator.

(12) *Psychologie individuelle—La description d'un object* (Pp. 296–332): A. Binet. Binet here again insists upon the importance of the study of the higher mental processes as a means for making advance in individual psychology, and describes in detail one such test. In studying younger children he had them give a description, from direct observation or from memory, of a photograph presenting a number of details. He notes the length of the descriptions, the amount of simplification (an average of only two-fifths of the objects presented in the photograph were described, and in passing from perception to memory one-third of the objects were forgotten), the kind of objects selected for description and the associations with the memory of the fable of which the photograph was a representation. He compares children of different ages, and finds that he can divide the individual children into four types, as follows: (1) the descriptive type, describing only objects, and especially their prominent characteristics, without attempting to seize their significance; (2) the observing type, fixing their attention especially on the subject of the scene, judging and interpreting what is perceived; (3) the emotional type, attaching emotional terms to the objects described (but this type is not necessarily emotional in ordinary life); and (4) the erudite type, who, in place of describing the picture, express their knowledge of its subject.

Binet applied the test also to older persons, placing before them, as object for description, a cigarette. He finds here also four types, identical with the above, with the exception that the emotional type does not appear; and a fifth is described: the idealistic, imaginative and poetic.

E. B. Delabarre.

Brown University.

SOCIETIES AND ACADEMIES.

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met January 19th, thirty persons present.

Dr. G. H. Parker described a double-mouthed *Metridium marginatum.* The characters and the two types of internal structure shown in the normal form were described and compared with *M. dianthus* and allied species. Specimens with two discs were estimated to occur one in 700. The habits of the young were noted, and a detailed description of the two-mouthed specimen given. Fission probably takes place in the young specimen; both œsophageal tubes are entirely distinct; all but one pair of mesenteries are non-directive; division takes place through the endocœls; longitudinal fission, through the later stages, was considered probable.

Mr. B. H. Van Vleck said that he had found specimens of *Metridium* with two discs rather more frequently than Dr. Parker's experience indicated; he had seen, perhaps, 12 or 15, and considered their numerical proportion about one in 200 or 300.

Mr. G. M. Winslow spoke of an abnormal *Amblystoma.* The embryo showed a supernumerary joint behind and below the left hind leg; the abnormal cartilages are separate from the normal cartilages; the muscles were described; the alimentary canal has a number of blind tubules; the arteries are contracted; the veins can be traced. The abnormal pelvic girdle is closest to the 14th vertebra.

Professor C. S. Minot discussed the morphology of the true kidney. In vertebrates there are three distinct organs called kidney, the head kidney, the middle kidney and the true kidney; two of these may occur in the life-history of a single vertebrate. In structure the three differ at all periods. There are two views concerning the development of the true kidney; it may be due to embryonic connective-tissue, or to an actual outgrowth of the walls of the duct; in the pig the evidence obtained is not conclusive. The true kidney is fundamentally different from its predecessor; the head and middle kidneys are without capillary organs; they may be placed in one class, and the true kidney separated into another class. Dr. Minot drew attention to the specimens illustrating his studies, and also to a preparation showing a symmetrical picture of the optic nerve of *Pimelodus.*

Dr. Parker showed an embryo kitten prepared to show the centers of ossification; after removing the viscera, the specimen had been subjected to alcohol, potash, water and glycerine.

SAMUEL HENSHAW,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 479th meeting of the Society was held Saturday evening, February 5th. The first address was by Professor H. W. Wiley on 'Useful Bacteria.' Professor Wiley said in substance: In one sense nearly all bacteria may be regarded as useful. The following remarks, however, apply to those which are useful in agriculture. The growing of our crops depends upon the activity of bacteria in the soil. Especially is this true in respect of their supply of nitrogenous food. The higher vegetables, as a rule, eat only nitric nitrogen, while the original conditions in which nitrogen enters the soil is largely in an organic form, totally unsuited to nourish plants. The nitro-organisms, which are the cooks and prepare the food of plants, belong to three classes: First, those bacteria, molds and yeasts which act upon organic nitrogenous matter and convert it into ammonia; second, those bacteria which act upon ammonia and convert it into nitrous acid; and third, the bacteria which convert the nitrous into nitric acid. The soil also contains ferments which are capable of oxidizing the free nitrogen of the air and converting it into forms suitable for plant food. It has been supposed that these bacteria live chiefly in symbiosis with leguminous plants and in nodules which are found on their roots. It is probable, however, that leguminous plants furnish simply the most favorable environment for the growth of these bacteria and that they may be able to convert free nitrogen into nitric acid entirely independent of other plant life. It may be, however, that there are two classes of organisms of this kind, one oxydizing free nitrogen in symbiosis and the other independently. Advantage is taken of this character of bacteria to cultivate them in a pure state and supply them in small bottles for fertilizing pur-

poses. The bacteria thus prepared are mixed with moist soil and, when they have propagated sufficiently, this soil is spread upon the field and thus the proper fertilizing ferments are introduced into the soil.

The second exercise was a paper by General Geo. M. Sternberg on 'Pathogenic Bacteria.' General Sternberg, in his paper, gave a general account of the modes of action of pathogenic bacteria and of the different channels of infection. He dwelt upon the fact that infection depends upon the degree of virulence of the pathogenic microorganism, upon the number introduced, and upon the susceptibility of the individual exposed to infection. This susceptibility depends upon inherited predisposition, upon reduced vital resisting power due to various depressing agencies, such as malnutrition, fatigue, mental depression, etc., and in certain cases upon a direct exciting cause, such as exposure to cold.

Localized infections were then discussed, including boils, abscesses, wound infection, erysipelas, pneumonia and diphtheria. Some account was also given of general blood infections (septicæmias), and of the pathogenic action of bacteria which multiply in the alimentary canal, producing toxic substances, which, being absorbed, give rise to more or less fatal forms of diseases, *e. g.*, cholera infantum, Asiatic cholera, etc.

The last paper of the meeting was by Mr. E. A. de Schweinitz, on 'Toxins and Antitoxins.' No abstract of this address has as yet come to hand.

E. D. Preston,
Secretary.

TORREY BOTANICAL CLUB, DECEMBER 14, 1897.

The first paper, by Professor Francis E. Lloyd, 'On an Abnormal Cone of *Pseudotsuga taxifolia*,' discussed the inner scales of a cone recently observed on a leader of the Douglas Spruce. He figured and described certain lateral expansions of the primitive scale, remarking that, although of a stipular nature, they are exceptional in their absence of vascular tissue. In the abnormal cone the absence of these expansions from all but the inner scales suggested several lines of explanation, which were discussed in some detail and with the promise of further elaboration.

Remarks were made by Judge Brown, Dr. Rusby and Mr. Howe.

Dr. Underwood commended Mr. Lloyd's attempt to secure phylogenetic evidence from the leaves of seedlings, and spoke of the great difficulty of securing such evidence from the external organs of plants, changing so rapidly as they do because exposed to the immediate action of their environment.

The second paper, by Mr. E. O. Wooton, 'Botanizing in New Mexico during the Summer of 1897,' gave an entertaining and graphic narrative of this collecting trip made by Mr. and Mrs. E. O. Wooton in Dona Ana and Lincoln counties, N. M., in last June, July and August. The route extended from the Rio Grande valley, at Mesilla, near the Mexican line, at an elevation of 3,900 feet, to Sierra Blanca Peak, at 11,000 feet. Special interest attached to the collections made from the southern end of the White Sands, a region about 30x6 miles or more in area, not before explored by a botanist, except that a half dozen plants had been gathered on its margin by Professor T. D. A. Cockerell, of Mesilla. This vast expanse of sand, seeming like a sea of white, is moving slowly to the east. Even its lizards are white. Several new grasses were obtained here, and other very peculiar species. Very extensive collections were made in this trip, though in the midst of great hindrances from the summer rains.

Discussion brought out the great dissimilarity existing between neighboring floras in New Mexico. Mr. Wooton's collections numbered about 30 sets of as many as 450 species (with perhaps 150 species more in parts). Mr. A. A. Heller, collecting meanwhile about 250 miles northward, among 300 numbers had but about 50 duplicates. Dr. Rusby, collecting sometime ago at a similar distance west, among 450 species had also but about 50 duplicates.

Further remarks were made by Professor Lloyd regarding his collections in Chihuahua, and by Dr. Rusby in commemoration of remarkable kindness received when destitute in the desert and conferred by Professor E. L. Greene.

Edward S. Burgess,
Secretary.

Harrison Allen

SCIENCE

FRIDAY, FEBRUARY 25, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE WASHINGTON ACADEMY OF SCIENCES.

THE scientific community of Washington is engaged in modifying its organization. The matter is of general interest, not only because of the importance of the body of investigators there assembled, but because the problems they are attempting to solve are analogous to the problems which confront the national scientific associations. There was a time when the American Association was the only scientific body of national scope, and, though it began as an association of geologists only, it gradually expanded in respect to subject-matter so as to provide sections for all important branches of scientific work. Of late years there has been a strong tendency toward independent organization of bodies of workers in various fields, and a score of national societies devoted to special subjects have sprung into existence, with the result that interest in and attendance on the meetings of the American Association have flagged.

In Washington the original organization was the Philosophical Society (1871), and its scope was as broad as science. Owing to peculiarities of its rules and customs, differentiation could not readily be accom-

plished by division into sections, and, as the scientific body grew, the students of special subjects organized separate societies, the Anthropologists in 1879, the Biologists in 1880, the Chemists and Entomologists in 1884, the Geographers in 1888, and the Geologists in 1893. The interest drawn toward these associations tended naturally to narrow the field of the Philosophical Society, and the only subjects remaining in its exclusive possession were physics, mathematics and astronomy.

There should be noted, however, an important difference between the National and Washington conditions. The American Association, although started by specialists, became a somewhat popular body and was peculiarly effective as an instrument for enlarging and extending popular interest in research. The special societies afterward organized are for the most part comparatively exclusive, being composed of experts and dealing with technical subjects. The Philosophical Society, on the other hand, had no popular tendency; it limited its membership narrowly, and excluded the press and public from its meetings, while several of the newer, specialized societies assumed popular functions. Their membership is practically open to all persons having sufficient interest to desire to enter, and the members are free to bring their friends to the meetings. The Geographic Society has gone much further than this, and courts a popular membership, to which it gives a generous course of illustrated lectures as compensation for annual dues.

Soon after differentiation began in Washington it became evident that divided interests were likely to affect unfavorably the general influence and external relations of the scientific body. Publishing through many channels, official and unofficial, Washington research makes comparatively little impression on the distant public, and even in our own country the fact is hardly realized that Washington is one of the world's chief centers of scientific investigation. Lacking a unified organization, workers in science were unable to secure for their collective opinion, as to matters of public policy affecting science, the consideration to which it was entitled. An effort was made in 1882 to unite all the societies by making them sections of an Academy, but the Philosophical Society, having the whole field of science within its designated scope, was unwilling to recognize the specialized societies as coördinate, and the project was abandoned. In 1888 a federation for business purposes was effected, under the title of the Joint Commission, and this has continued to the present time. At first it was a committee of delegates, but it was afterward enlarged so as to include the executive boards of all the societies. It published a joint directory of the membership, conducted courses of popular lectures and assumed various minor functions. In 1896 it became an instrument for the expression of the opposition of scientific men to the anti-vivisection bill, then pending in Congress, and it also officially endorsed the proposal of the Secretary of Agriculture that the scientific bureaus of the Department of Agriculture be placed under a 'Director,' who should be a scientific

man with status independent of politics. In the mode of procedure adopted by the Commission in attempting to influence legislation it was thought to exceed its constitutional powers, and the criticisms which ensued were among the influences which determined the societies to a reconsideration of the general subject of their federation. Much attention has been given to the matter during the past winter, with the result that a 'Washington Academy of Sciences' has been determined on, which shall be the federal head of the existing scientific societies. It is to have no control over the 'affiliated societies,' which retain their autonomy, but its members are to be chosen exclusively from the membership of the societies, its vice-presidents are to be nominated by the societies, and it is to have charge of all matters affecting the general and collective interest of their membership. Great pains has been taken in the selection of its nucleus, so that it shall be a thoroughly representative body from the start. The Joint Commission, itself a body of 96 persons, has by ballot chosen from the full membership of the societies 75 men, the criterion of selection being 'original research or scientific attainment,' and the nucleus of 75 is to organize the Academy and enlarge its membership. The policy of the new Academy and the choice of functions to which special prominence shall be given are yet to be determined; but its progress will be watched with interest and expectation, especially by those who appreciate the importance of the problem to be solved by the national organizations.

*THE SMITHSONIAN INSTITUTION.**

FINANCES.

THE unexpended balance at the beginning of the fiscal year July 1, 1896, as stated in my last annual report, was $57,065.78. Interest on the permanent fund in the Treasury and elsewhere, amounting to $56,400, was received during the year, which, together with a sum of $6,128.71 received from the sale of the publications and from miscellaneous sources, made the total receipts $62,528.71.

The disbursements for the year amounted to $58,061.99, the details of which are given in the report of the executive committee. The balance remaining to the credit of the Secretary on June 30, 1897, for the expenses of the Institution, was $61,532.50, which includes the sum of $10,000 referred to in previous reports, being $5,000 received from the estate of Dr. J. H. Kidder, and a like sum from Dr. Alexander Graham Bell, the latter a gift made personally to the Secretary to promote certain physical researches. This latter sum was, with the donor's consent, deposited by the Secretary to the credit of the current funds of the Institution.

This balance also includes the interest accumulated on the Hodgkins donation, which is held against certain contingent obligations, besides relatively considerable sums held to meet obligations which may be expected to mature as the result of various scientific investigations or publications in progress.

The permanent funds of the Institution are as follows:

Bequest of Smithson, 1846		$515,169.00
Residuary legacy of Smithson, 1867		26,210.63
Deposits from savings of income, 1867		108,620.37
Bequest of Jas. Hamilton, 1875	$1,000.00	
Accumulated interest on Hamilton fund, 1895	1,000.00	
		2,000.00

*Abstract from the report of S. P. Langley, Secretary of the Smithsonian Institution, for the year ending June 30, 1897.

Bequest of Simeon Habel, 1880	500.00
Deposits from proceeds of sale of bonds, 1881	51,500.00
Gift of Thomas G. Hodgkins, 1891	200,000.00
Portion of residuary legacy, T. G. Hodgkins, 1894	8,000.00
Total permanent fund	912,000.00

The Regents also hold certain approved railroad bonds, forming a part of the fund established by Mr. Hodgkins for investigations of the properties of atmospheric air.

By Act of Congress approved by the President March 12, 1894, an amendment was made to Section 5591 of the Revised Statutes, the fundamental act organizing the Institution, as follows:

The Secretary of the Treasury is authorized and directed to receive into the Treasury, on the same terms as the original bequest of James Smithson, such sums as the Regents may, from time to time, see fit to deposit, not exceeding, with the original bequest, the sum of $1,000,000; *Provided*, That this shall not operate as a limitation on the power of the Smithsonian Institution to receive money or other property by gift, bequest or devise, and to hold and dispose of the same in promotion of the purposes thereof.

Under this section, 5591 of the Revised Statutes, modified as above noted, the above fund of $912,000 is deposited in the Treasury of the United States, bearing interest at 6 per cent. per annum, the interest alone being used in carrying out the aims of the Institution.

During the fiscal year 1886–97 Congress charged the Institution with the disbursement of the following appropriations:

For International Exchanges	$19,000
For North American Ethnology	45,000
For United States National Museum:	
Preservation of collections	153,225
Furniture and fixings	15,000
Heating and lighting	13,000
Postage	500
Repairs to buildings	4,000
Rent of Workshops	2,000
Galleries	8,000
For National Zoological Park	67,000
For Astrophysical Observatory	10,000

The executive committee has examined all the vouchers for disbursements made during the fiscal year, and a detailed statement of the receipts and expenditures will be found reported to Congress, in accordance with the provisions of the Sundry Civil Acts of October, 2, 1888, and August 5, 1892, in a letter addressed to the Speaker of the House of Representatives.

The vouchers for all the expenditures from the Smithsonian fund proper have been likewise examined and their correctness certified to by the executive committee, whose statement will be published, together with the accounts of the funds appropriated by Congress, in that committee's report.

The estimates for the fiscal year ending June 30, 1898, for carrying on the Government interests under the charge of the Smithsonian Institution, and forwarded as usual to the Secretary of the Treasury, were as follows:

International Exchanges	$23,000
American Ethnology	50,000
National Museum:	
Preservation of collections	180,000
Furniture and Fixtures	30,000
Heating and lighting	15,000
Postage	500
Galleries	8,000
Repairs to buildings	8,000
Removal of sheds	2,500
Rent of workshops	2,000
National Zoological Park	75,000
Astrophysical Observatory	10,000

AVERY FUND.

In regard to the bequest of Mr. Robert Stanton Avery, referred to in previous reports, a definite settlement has not been reached with the heirs at law, so that it is not possible to state the exact amount that this fund will reach.

BUILDINGS.

No important changes were made in the Smithsonian Building during the year. Two museum storage sheds adjacent to the

building have been removed, with a great improvement in the appearance of the south front, while at the same time a source of danger from fire is averted. It is still necessary to retain some workshops south of the western portion of the building, no rooms being elsewhere available, but it is hoped that these also will soon be removed.

I may call attention to the need of additional room for the proper storage of such publications of the Institution and its bureaus as must be retained in reserve. These are comparatively few in number for each particular work, but the accumulations of fifty years occupy in the aggregate so much space as to demand more storage room than is now available and create a positive danger in the excessive weight that is now placed upon the floors of upper stories, while the work of distribution of publications is now carried on in very inconvenient and inaccessible quarters. I have under consideration the feasibility of some changes in the interior arrangement of the main north and south towers of the building which would render suitable for storage purposes much space which can not now be utilized.

I may also mention the very decided improvement that would result from the remodeling of the steep and long iron stairways leading to the great hall of the building, which is now used for archæological collections.

The improvements in progress in the Museum by the erection of galleries in several of the halls are alluded to elsewhere.

RESEARCH.

Although the time of the Secretary must be almost wholly given to administrative affairs, yet, as in years past, in carrying out the wish of the Regents and in continuation of investigations begun prior to my connection with the Institution, I have devoted such time as I could spare to researches upon the solar spectrum and to experiments in connection with certain physical data of aerodynamics.

Both of these investigations have reached a stage at which it is possible to give to the world somewhat full statements of results. In my remarks on the operations of the Astrophysical Observatory I discuss more fully the researches upon the solar spectrum.

In my report for the previous year I brought to the attention of the Board the fact that my experiments in aerodynamics had finally resulted in a successful trial on May 6, 1896, of a mechanism, built chiefly of steel and driven by a steam engine, which made two flights, each of over half a mile, and I appended a brief statement of my own and of Mr. Alexander Graham Bell, originally communicated in French to the Academy of Sciences of the Institute of France, describing the actual flight. Since that time a third and a much longer flight was made on November 28, 1896, with another machine, built of steel like the first and driven like that by propellers actuated by a steam engine of between 1 and 2 horsepower, making a horizontal flight of over three-quarters of a mile and descending in safety.

I have thus brought to the test of actual successful experiment the demonstration of the practicability of mechanical flight, which has been so long debated and till lately so discredited. To satisfy a nearly universal interest, I am now engaged in the preparation of a full description of these experiments since 1891, when my first memoir on aerodynamics was published. This memoir, with those on 'Experiments in Aerodynamics' and 'Internal Work of the Wind,' will form volume 27 of the Smithsonian contributions to knowledge, which will thus contain a complete record of all experiments carried on thus far under my direction upon this subject.

HODGKINS FUND.

The Hodgkins medals of award were received at the Institution on the 13th of July, 1896, and were transmitted on the same day to those competitors for the Hodgkins fund prizes who were recommended by the committee to receive medals. A replica of the medal was sent to each of the members of the Hodgkins advisory committee and to certain specialists who, without compensation, had rendered valuable aid in connection with the competition. A replica was also sent to the firm of Evarts, Choate & Beaman, the legal counsel of Mr. Hodgkins, and to Dr. Chambers, his medical adviser and longtime friend, as a memento of valued services rendered in connection with the Hodgkins bequest to the Institution.

In July, 1896, Mr. E. C. C. Baly, of University College, London, a Hodgkins competitor, whose memoir received honorable mention, was awarded a grant of $750 to enable him to prosecute further his investigations on the decomposition of the atmosphere by means of the passage of the electric spark. A report of the research, so far as it has progressed, has been received from Mr. Baly.

Under an additional grant to Dr. S. Weir Mitchell and Dr. John S. Billings investigations have been conducted in the Laboratory of Hygiene of the University of Pennsylvania, upon the effect which a prolonged exposure to vitiated air has upon the power of individuals to resist infectious diseases. Dr. D. H. Bergey, who conducted the experiments, reports that he subjected certain animals to an impure atmosphere, and found that while it apparently lowered their vitality he was unable to attenuate the fluids used for inoculating the diseases so that they would kill such a weakened animal while not affecting a vigorous one. Still, animals inoculated for tuberculosis died much earlier when exposed to impure air. As these results may doubtless be applied to all warm-blooded animals, including man, it would appear that we have here an important confirmation of the clinical observation that tuberculosis thrives most in vitiated air.

January 15, 1897, a grant of $500 was made to Mr. A. Lawrence Rotch, Director of the Blue Hill Meteorological Observatory at Readville, Mass., to be used in securing automatic kite records of meteorological conditions at an altitude of 10,000 feet or more. An additional grant of $400 was later made to Mr. Rotch for continuing his experiments in connection with the explorations of the upper air.

With a view to being prepared to apply most advantageously the accruing interest from that portion of the fund devoted to investigations connected with the atmosphere, the Secretary has conferred, during the year, with specialists in this country and Europe, upon the subject of researches suitable to be aided from the Hodgkins fund.

The six Hodgkins memoirs which have been published by the Institution were issued in February and March, 1897, and a copy of each was sent to all persons who had submitted papers in connection with the competition.

NAPLES TABLE.

As stated in my last report, the Institution has renewed the lease of the Smithsonian table at the Zoological Station of Naples for a second term of three years, this action being in accordance with the urgent solicitation of the faculties of several colleges and universities and of many of the leading biologists of the country.

At my earnest request Dr. Billings has continued as Chairman of the Advisory Committee, which has rendered most efficient aid in examining testimonials and in recommending action with regard to appli-

cations for the occupancy of the table. The following applications have been favorably acted upon:

Dr. F. H. Herrick, professor of biology at Adelbert College, Cleveland, occupied the table in November, 1896, and Dr. S. E. Meek, formerly of the Arkansas Industrial University, but more recently connected with the United States Fish Commission, received the appointment for two months in the spring of 1897. The application of Dr. H. S. Jennings, of the University of Michigan and later of Harvard, was approved for the three months during the spring and summer of 1897. Through the continued courtesy of Dr. Dohrn, in permitting two persons nominated by the Institution to occupy tables at the same time, the residence of Dr. Jennings began before the termination of Dr. Meek's appointment. Applications for the coming year are now under consideration.

EXPLORATIONS.

Ethnological and natural history explorations have been continued under the direction or with the assistance of the Institution in various parts of the world by the Bureau of Ethnology and the National Museum. This work is more fully described elsewhere, but I may mention here that a large number of objects of interest from various parts of the world have been added to the Museum collections, and much valuable information has been acquired regarding the history and the language of the American Indians. Among the explorations of the year were those by Dr. William L. Abbott in Siam, Professor O. F. Cook in Africa, Dr. E. A. Mearns in Minnesota and elsewhere, Mr. Frank H. Cushing in Maine, Mr. J. W. Fewkes in Arizona, Mr. E. T. Perkins in Idaho, Mr. W J McGee in Iowa, Mr. J. B. Hatcher in Patagonia and Tierra del Fuego, and Dr. Willis E. Everette in Oregon, British Columbia and Mexico.

PUBLICATIONS.

The publications of the Institution and its bureaus during the year comprised two works in quarto form, four in royal octavo, and fourteen in octavo, aggregating 9,630 pages, covering to a greater or less degree nearly all branches of human knowledge.

The Smithsonian Institution proper issues three series of works: The Contributions to Knowledge, the Miscellaneous Collections, and the Annual Report. By the bureaus of the Institution there are issued the Annual Report and the Bulletin of the Bureau of American Ethnology and the Proceedings and Bulletin of the National Museum, and the Secretary transmits to Congress the Annual Report of the American Historical Association. The Smithsonian Contributions and Miscellaneous Collections are printed at the expense of the Institution and the other publications from Congressional appropriations.

Contributions to Knowledge.—Two memoirs to this series were issued during the year, both having been submitted in competition for the Hodgkins fund prizes.

The memoir by Lord Rayleigh and Professor Ramsay describes the discovery of argon, for which achievement the authors were awarded the first Hodgkins fund prize of $10,000. It gives an account of the reasons which led the investigators to suspect the existence of a new element in the atmosphere and a detailed description of the apparatus and methods by which the presence of this hitherto unknown gas was definitely established. The importance of the discovery was recognized independently by the Institute of France, which awarded a prize of 50,000 francs, and by the National Academy of Sciences, which granted to the discoverers the Barnard medal.

The memoir by Professor E. Duclaux, of Paris, entitled Atmospheric Actinometry and the Actinic Constitution of the Atmosphere, describes the methods and results of

numerous experiments on the chemical rays of the sun by the exposure of oxalic acid to their action. Professor Duclaux found that the chemical action of the rays when the sky was overcast was much less than on a fine day and that with light cumulus clouds the combustion might be more active than with a clear blue sky or slight cirrus, so that it appeared evident that the chemical activity and hygienic power of the sun's rays are not related to the apparent fineness of the day.

Miscellaneous Collections.—Nine papers of the 'Miscellaneous' series were issued and others are in progress. The completed works were Smithsonian Physical Tables, by Professor Thomas Gray; Equipment and Work of an Aerophysical Observatory, by Alexander McAdie; Air in Relation to Human Life and Health, by Professor F. A. R. Russell; Air of Towns, by Dr. J. B. Cohen; Air and Life, by Dr. Henri de Varigny; Mountain Observatories, by Professor E. S. Holden; Methods of Determining Organic Matter in the Air, by Dr. D. H. Bergey; Recalculation of Atomic Weights, by Professor F. W. Clarke, and Virginia Cartography, by P. Lee Phillips.

The Catalogue of Scientific and Technical Periodicals, by Dr. H. Carrington Bolton, mentioned in my last report, is in type and will soon be published. It comprises the titles of more than 8,500 scientific and technical periodicals in all languages, adding 3,500 titles to the first edition, published in 1885.

There is also completed, ready for the printer, a voluminous supplement to Dr. Bolton's Select Bibliography of Chemistry.

As a special work, there has been printed the International Exchange List of the Smithsonian Institution, being a list of the foreign correspondents, aggregating 9,414 learned societies, museums, universities, etc., with which American publications are exchanged.

Annual Reports.—The Smithsonian Annual Report is in two volumes, one of which is devoted to the work of the National Museum. In the general appendix of Part I. are included memoirs on all branches of knowledge, selected chiefly from publications of learned societies of the world that are not readily accessible to the public, the basis of selection being that the papers are written by a competent person, give an account of some important or at least interesting scientific discovery, are untechnical in language and suitable to nonprofessional readers.

The History of the First Half Century of the Smithsonian Institution, outlined with some detail in my last report, is now printed and will soon be issued. The Institution was founded August 10, 1846, by Act of Congress approved by President Polk, and it seemed an appropriate memorial of the completion of its first fifty years to publish a volume which should give an account of its origin and history, its achievements and its present condition.

The editorial supervision of the volume was undertaken by the late Dr. G. Brown Goode, and to his thorough acquaintance with the history of the Institution, and his skill and critical knowledge, the comprehensive plan of the work is entirely due. At the time of his death, in September, 1896, the manuscript was sufficiently advanced to permit of its completion on his general plan.

The volume is royal octavo of 866 pages, with a preface by William McKinley, President of the United States, ex-officio the head of the establishment. It is illustrated by full-page portraits of James Smithson, the Chancellors, several of the Regents, the three Secretaries, and of Assistant Secretary Goode, besides illustrations of the Smithsonian Building and of the infra-red spectrum investigations by the present Secretary. The main divisions of the work

are fifteen chapters, descriptive of the history of the Institution, and a like number of chapters giving appreciation of its work in the several branches of knowledge, mainly by persons not connected with the Institution, followed by an appendix of 8 pages narrating the principal events in its history.

Since it is impossible in a single volume to exhaust the subject it became necessary to mention but briefly many topics which it was hoped might be elaborately treated. The book is printed from type in an edition of 2,000, with 250 additional copies on handmade paper. It is now classed in either of the regular series of Smithsonian publications, and will receive a special rather than a general distribution. This course is found necessary by reason of the cost of the work.

The Annual Report of the Museum for 1894, which includes several special papers by Museum officers or collaborators, has been issued, and the Museum has published a volume of Proceedings, and separate papers of other volumes, besides two octavo and two quarto bulletins, the contents of all of which are given elsewhere.

The Bureau of Ethnology has published three reports, the fourteenth, fifteenth and sixteenth, bringing the work down to the close of the fiscal year 1894–95.

The Annual Report of the American Historical Association for 1895 has been published, and the report for 1896 has been sent to the printer. These reports are transmitted by the Secretary of the Association to the Secretary of the Institution, who submits the whole or portions of the reports to Congress, in accordance with the act of incorporation of the Association. Prior to the report for 1894 the Institution had no share in the distribution of these volumes, but, beginning with the report for 1894, a limited number is available for purposes of exchange by the Institution with historical and other learned societies of the world. The reports contain papers relating to American history or to the study of history in America. A most important contribution in the report for 1895 is a bibliography of the historical societies of the United States and British America, covering 561 printed pages, which is a very useful reference work for writers and students of American history.

LIBRARY.

The library continues to grow steadily, the accessions in volumes, parts of volumes, pamphlets and charts reaching 35,912 during the past year. Special mention should be made of the gift of Mr. S. Patcanof, of St. Petersburg, of over 300 volumes, consisting mostly of oriental works and including some Arabic manuscripts and many rare Armenian publications.

As stated in my last report, the Secretary of State had named, in accordance with my suggestion, Dr. John S. Billings, United States Army, retired, Director of the New York Public Library, and Professor Simon Newcomb, United States Navy, Superintendent of the Nautical Almanac, as the delegates of the United States to a conference to be held at the instance of the British government at London in July, 1896, to consider the preparation of an international catalogue of scientific literature. This conference met July 14 to 17, 1896, twenty-two countries being represented. The conference drew up a plan which the respective delegates submitted to the countries they represented. The report of Professor Newcomb and Dr. Billings, submitted to the Secretary of State, October 15, 1896, recommended that the United States government should take part in this work and that the Smithsonian Institution be made the agent of the Government in this important scientific enterprise.

In accordance with this suggestion the

Secretary of State invited my opinion as to the propriety and feasibility of the United States taking part in this work through the Smithsonian Institution, and requested an estimate of the probable expense attendant thereto. To this I replied that I fully concurred in the view of the delegates as to the great importance of a successful execution of the conclusions of the conference and as to the propriety of this government taking its share of the proposed work by providing for the cataloguing of the scientific publications of the United States. This opinion is strengthened by the fact that the recommendations made are due to results emanating from an international conference, at which the United States was officially represented. and by the further considerations that the benefits to be derived from this undertaking are not only great and far-reaching for the scientific progress of America, but also of universal value, and that all the great and many of the smaller nations will take part in the work. I recognized also the propriety of the suggestion that the government should employ the Smithsonian Institution as an agent in this matter, particularly since the Institution first suggested this subject in 1855, and since it has been from its earliest organization interested in scientific bibliography.

I was, however, reluctant to commit the Institution to the appearance of soliciting Congress in this matter in any case, or to the undertaking of the enterprise, however worthy, unless provision could be made for the necessary expenses of the work. After considering the subject, it seemed to me that the work, if assigned to the Smithsonian Institution, would require a person of special qualifications to immediately assist the Secretary, together with a number of trained clerical assistants, and that the salaries for these persons and the expenses incident to the work would require an appropriation of not less than $10,000 per annum.

In accordance with this recommendation, Secretary Olney transmitted this correspondence to Congress. Although the Catalogue will not begin until 1900, much preliminary work will be necessary. I have accordingly brought the matter to the attention of Secretary Sherman, and the Department of State has agreed to submit an item for this purpose in its regular estimates for the year 1898–99.

Although the new building for the Library of Congress was completed in February, 1897, its occupancy had not begun at the close of the fiscal year. The east stack was provisionally assigned for the Smithsonian collection of transactions. In the past only this portion of the Smithsonian Library has been kept together, the remainder of the collection being distributed throughout the Library of Congress. I trust that in the new building, with its ample space and largely increased force, it will be found possible, in accordance with the resolution of the Regents in 1889, to assemble the entire collection in one place.

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*HARRISON ALLEN.**

IN Harrison Allen this Association has lost one of its founders and most active members and its second president; science has lost a devotee; medicine has lost a specialist of high rank; the community has lost a man of lofty character and broad culture; there are doubtless others beside myself upon whom the announcement of his death on the 14th of November fell with the shock of personal bereavement, great and irreparable. During the present week Dr. Allen and his family were to have been my guests. What contrast could be greater than between the joys anticipated and the sad reality of the tribute which, at the re-

* Read before the Association of American Anatomists at its Tenth Meeting, December 28, 1897.

quest of our president, is now offered to the memory of our collaborator and friend?

Harrison Allen was born in Philadelphia April 17, 1841. His parents were Samuel Allen and Elizabeth Justice Thomas. His ancestors accompanied William Penn, and on his father's side he was descended from Nicholas Waln, distinguished in the early history of Philadelphia. As a boy Harrison was interested in Natural History, and at or before sixteen he went on an extended walking and camping trip in western Pennsylvania with associates of like tastes, amongst whom was George Horn, also lately deceased. Although he would have preferred pure science, financial considerations led him to study medicine, including dentistry.

After gaining his M.D. at the University of Pennsylvania, he was on duty for a time at the Blockley Hospital in his native city. On the 31st of January, 1862, he was appointed Acting Assistant Surgeon U. S. A., and Assistant Surgeon, July 30, 1862, serving in hospitals and in the defences of Washington until the acceptance of his resignation, December 8, 1865. He then ranked as Brevet Major. It was during the winter of 1862–63 that I first made his acquaintance at a meeting of the Potomac Side Naturalists' Club, attended also by Elliott Coues, Theodore Gill and others. Our army service did not throw us together, and I little thought then how dear Dr. Allen was to become to me in later years; for ten summers, indeed, we have been near neighbors at Nantucket, and I have been looking forward to the time when less pressure of work would permit me to enjoy his society more fully.

Dr. Allen now practised his profession with diligence and success. His dental education facilitated specialization in respect to the air passages, and in 1880 he was President of the American Laryngological Association. Of his strictly medical and surgical publications (numbering about fifty) nearly all relate more or less directly to his specialty.

But while he earned his living by medicine, it was in science that he lived, and it is this side of his career that interests us more as members of this Association. The subject of his thesis at graduation was 'Entozoa Hominis,' probably suggested by his beloved teacher, Joseph Leidy. His first scientific paper appeared in July, 1861, in the Proceedings of the Academy of Natural Sciences, and treated of certain bats brought from Africa by the explorer Du Chaillu; besides the two editions of his monograph of the bats of North America, published by the Smithsonian Institution in 1864 and 1893, respectively; to the same highly specialized mammals were devoted thirty of his scientific papers; just before his death he completed articles on the Glossophaginæ and on the genus *Ectophylla*. Yet, while remaining throughout life true to his first scientific love, Dr. Allen published valuable notes or memoirs upon many other subjects, notably the joints, the muscles, locomotion and crania; only a week before he died he handed over to the Wagner Institute of Science a study of the skulls from the Hawaiian Islands, much more elaborate than the previous one of the Florida crania. To him also was appropriately conceded the privilege of dissecting and describing the remarkable Siamese Twins.

Dr. Allen was emphatically, and in a double sense, a *fine* anatomist. So far as I know he seldom used the compound microscope, and availed himself little of the multifarious devices, chemical and mechanical, of modern histology. But his dissections of delicate organs were simply exquisite, demanding the most perfect training of hand and eye. Yet his habitual devotion to creatures of minor size did not deter him, during the past summer, from offering to

superintend, in behalf of the United States National Museum, the preparation of the skeleton of a sperm whale that came ashore near his seaside home.

Besides the papers and volumes already mentioned, Dr. Allen published, in 1877, 'Outlines of Comparative Anatomy and Medical Zoölogy,' and in 1881 completed an elaborate treatise on Human Anatomy, wherein stress is laid upon the medical and surgical bearing of the facts of human structure. Finally, and rightly to be mentioned in exemplification of his broad culture and sympathies, here is a discussion of 'The Life Form in Art,' and here an address on 'Poetry and Science,' delivered before a Browning Society. Nor must it be forgotten that music had always charms for our friend, and that he was an admirable player upon the flute.

But Dr. Allen was not merely a successful practitioner and an eminent investigator; he was also a teacher. In the University of Pennsylvania he was professor of zoology and comparative anatomy from 1865 to 1876, professor of physiology from 1878 to 1885; emeritus professor of physiology to 1891; professor of comparative anatomy and zoology, 1891–1896. He had been connected with his *alma mater* for more than thirty years, a period exceeded only in the case of five other professors. Dr. Allen was an active or corresponding member of numerous scientific societies in this and other countries, and was President of the American Society of Naturalists in 1887 and in 1888. A large part of his work was done at the Academy of Natural Sciences and published in its *Proceedings*.

The climax of Dr. Allen's useful and honorable career was reached in 1891. He was then fifty years of age, and for half that time had been connected with the University. In 1891 he became professor of comparative anatomy and zoology; President of the Contemporary Club of Philadelphia; Curator of the newly established Wistar Institute of Anatomy; President of the Anthropometric Society; then, too, he succeeded Professor Leidy in the presidency of this Association, holding office for two terms, or four years. No such combination of honors and responsibilities within a single year is known to me. During 1891 he published a dozen separate papers or addresses.

On the 29th of December, 1869, Dr. Allen married Miss Julia A. Colton; she survives him, together with a daughter, Dorothea W., and a son who bears his father's name, and who has already begun the study of the profession in which his father attained such eminence. Dr. Allen's private collections of bats and other specimens were bequeathed to the Academy of Natural Sciences. As a member of the American Anthropometric Society he directed that his brain should be entrusted to that organization. His body was cremated. The autopsy revealed the cause of his death as heart-failure, due to fatty degeneration; he had of late years also been subject to rheumatism.

It is idle to speculate as to what Dr. Allen might have achieved in pure science had his health been more robust, his nature more aggressive, and his time more nearly at his own disposal. For in considering the extent and value of his publications we must take into account two potent factors in his life: first, he was in active practice; secondly, he was eminently conscientious and recognized to the full that his patients were entitled to the best that he could do. Gratuitous attendance upon those unable to pay is so general in the medical profession that it would be invidious in me to more than record my personal knowledge of cases in which Dr. Allen's skill was exercised at his serious personal inconvenience and when in need of rest.

Whether due to his Quaker ancestry or

to principle, Dr. Allen was non-combative, and sometimes suffered injustice rather than engage in controversy. But in the advocacy of a principle he could be tenacious and even aggressive. Twenty-one years ago, during Huxley's visit to this country, an address on Medical Education was interpreted by Dr. Allen as controverting his doctrine as to the inclusion of Comparative Anatomy in a medical course. He promptly protested in a daily journal and discussed the subject with marked emphasis in a paper before the American Association for the Advancement of Science, in 1880. In view of the enormous prestige of Huxley's utterances upon any subject at that period, opposition to him demanded no little courage.

Preëminent among Dr. Allen's many admirable traits was his readiness to recognize the good qualities of others. Even respecting bores or those who wronged him I do not recall an unkind remark. So decided, indeed, was his predisposition to find some extenuating quality in even the most flagitious transgressor that had the devil been objurgated in his presence we may imagine him to add: "His satanic majesty has doubtless many sins to answer for, but let us not forget his extraordinary ability, activity, and enterprise."

In this package are all my letters from Dr. Allen, nearly forty in number. The first is dated December 2, 1867. As may be imagined, many of the more recent discuss the formation, progress and prospects of this Association. The second letter so clearly exhibits his modesty, his unselfishness, and his loyalty to his friends, that I quote from it.*

I could occupy much time with details of my dear friend's life and nature, but content myself with enumerating what seem to me rare combinations of characteristics. An ardent naturalist, and daily handling specimens variously preserved, he was fastidiously neat in person and apparel. He was simple in his tastes, yet conformed to the customs of the most conventional of cities. Rigid in the performance of duty, yet considerate of the shortcomings of others. Dignified, but not haughty. Affable, yet insisting upon the respect due to scholarship and culture. A delightful conversationalist, yet an equally accomplished listener. Mirthful, yet never condescending to buffoonery. Sociable in the company of men, yet neither uttering nor tolerating what might not be said before the other sex. Emulous of all excellence, yet never envious of those who surpassed him in special directions. "Let us cherish his memory and profit by his example." Nay, perhaps, take warning therefrom. For, humanly speaking, had he worked less incessantly, and especially less far into the night, he might be with us to-day.

Intimate as we were, and freely as we conversed upon matters involving the duties of human beings toward one another, no theologic point was ever mentioned between us, and I am absolutely ignorant of the nature of his religious convictions. But whatever may have been his belief, and whatever may be our own, I feel that no violence is done by the repetition of three verses of the twenty-fourth Psalm that have arisen in my memory repeatedly during the past six weeks while reflecting upon Harrison Allen:

"Who shall ascend into the hill of the LORD? or who shall stand in his holy place? He that hath clean hands, and a pure heart; who hath not lifted up his soul unto vanity, nor sworn deceitfully. He shall receive the blessing from the LORD, and righteousness from the God of his salvation."

BURT G. WILDER.

CORNELL UNIVERSITY.

*There was then vacant a high position for which he had been strongly recommended by one who had declined it. He asked if I were a candidate, implying that if so he would withdraw. Under date of December 16, 1896, he wrote: "I shall gladly be your disciple in all matters of nomenclature."

HIGH SCHOOL BOTANY.

IN the Nebraska High School Manual, issued December, 1897, by the University of Nebraska, and the State Superintendent of Public Instruction, directions are given as to the teaching of Botany in the State High Schools, and especially those which are 'accredited' by the University. The substance of these directions may well receive the wider publicity which SCIENCE can give them.

"One year should be given to the study of plants in the high school. The old practice of beginning in the spring is no longer regarded as advisable by educators. The study may be made to alternate with some other subject, as Zoology or Physiology, or the alternate days may be used for laboratory work."

"Modern Botany requires a properly equipped laboratory. The room set apart for it must be well lighted, preferably from the north sky. It should be provided with firm tables 27 or 28 inches high, and there should be shelves and cases at the sides of the room. The microscopes must be from some good maker, so as to insure good results." Instruments by well known foreign and American makers are suggested, ranging in price from $16 to $20, and magnifying from 75 to 600 diameters. Dissecting sets and other necessary appliances are enumerated and their cost given.

"Some work may be done by the class, under the direction of the intelligent teacher, with but one microscope and the other appliances, but as soon as possible there should be in every high school six microscopes, each with its accompanying accessories. There should be, at the least, one-fifth as many microscopes as there are pupils in the class."

"*The Laboratory Work.*—In this year of work the pupil should study such selected plants as will give him a general outline of the Vegetable Kingdom, including a fair knowledge of the principal types of plants and the modifications they have undergone. For this purpose the following plants are recommended:

1. One or more protophytes, from the following list: *Chroococcus, Oscillaria, Nostoc, Bacillus.*

2. Several green seaweeds from the following: *Protococcus, Spirogyra, Vaucheria, Cladophora, Oedogonium,* and their degraded relatives *Mucor, Albugo, Peronospora,* etc.

3. At least one of the brown seaweeds: *Laminaria* or *Fucus.*

4. At least one of the red seaweeds: *Polysiphonia, Polcamium,* or *Corallina.*

5. Several sac-fungi, from the following lists: (*a*) *Erysiphe, Microsphaera, Podosphaera,* etc.; (*b*) *Plowrightia, Peziza;* (*c*) *Puccinia, Ustilago.*

6. Several higher fungi, from the following lists: (*a*) *Lycoperdon, Secotium, Ithyphallus;* (*b*) *Agaricus, Polyporus, Stereum.*

7. At least one of the mosses: *Mnium, Bryum, Timmia, Funaria* or *Hypnum.*

8. At least one of the fernworts: *Asplenium, Cystopteris, Pteris, Equisetum, Lycopodium* or *Selaginella.*

9. At least one of the gymnosperms: *Pinus, Larix, Abies* or *Picea.*

10. At least six angiosperms, as follows: (*a*) two monocotyledons, one of which has superior ovaries, as *Alisma, Trillium, Lilium, Erythronium,* etc.; the other with inferior ovaries, as *Iris, Amaryllis, Orchis, Spiranthes,* etc.; (*b*) four dicotyledons, one with superior ovaries and choripetalous corolla, as *Ranunculus, Capsella, Viola, Silene, Callirrhoë, Geranium, Potentilla, Fragaria, Astragalus,* etc.; another, with superior ovaries and gamopetalous corolla, as *Primula, Steironema, Phlox, Hydrophyllum, Lithospermum, Ipomoea, Physalis, Pentstemon, Mentha, Salvia,* etc.; a third, with inferior ovaries and choripetalous corolla, as *Epilobium, Oenothera, Mentzelia, Opuntia, Aralia, Cornus, Daucus, Pastinaca, Osmorrhiza,* etc.;

and a fourth, with inferior ovaries and gamopetalous corolla, as *Sambucus*, *Viburnum*, *Houstonia*, *Galium*, *Campanula*, *Vernonia*, *Aster*, *Helianthus*, etc.

In the foregoing work the pupil should get some idea of the structure of the whole plant. He should learn enough technical descriptive terms so that he can give intelligent descriptions of each plant. At every stage of the work the pupil should be required to make careful drawings in his note-book, accompanied by concise descriptions of essential characters."

Suggestions as to the proper selection of books for a small botanical library and the collection of a reference herbarium are given. Field work and the systematic determination of plants are encouraged, this work being regarded as a desirable part of the pupil's training, although it must not be permitted to occupy so large a portion of his time as was formerly the general custom.

It may interest botanists in colleges as well as in high schools to know that before these directions were issued a considerable number of the Nebraska high schools were already giving essentially the work outlined above, and there are many indications that encourage us to hope that it will not be long before this will be true of all.

CHARLES E. BESSEY.

EXTRA-ORGANIC EVOLUTION.

IN explaining the method of evolution Darwin and Wallace have laid great stress upon the struggle between *organisms*, Roux upon the struggle between the *parts of the organism*, and Weismann upon the all-sufficiency of natural selection. Darwin emphasizes *organic selection*, Roux *intra-organic selection*, and Weismann *germinal selection*. All progress is thus apparently organic. Heredity, at least with Weismann, is the continuity of the germ plasm, and progress is due to the survival and accumulation of advantageous congenital variations *within* the organism.

I wish to speak of what I may call *extra-organic* evolution. Progress has marched with colossal strides during the last fifty and even twenty years. Nevertheless, we see no corresponding advances made organically which may be deemed adequate to such progress. As far as our congenital or blastogenic qualities are concerned, we are probably little if any better than our forefathers of fifty or a thousand years ago. The progress actually made is out of all proportion to the advances made in our organisms.

Our sense and motor organs are essentially instruments and tools. So also, for that matter, is the brain. They are sifters, sentinels, receivers, transmitters, etc., all pressed into the service of the organism or some of its parts. The eye is manifestly an optical instrument, though a poor one, when compared with that additional eye or sense organ, the microscope or telescope. It is a well-known fact that it suffers from every defect that can be found in an optical instrument. It was useful in its time, and is so, I presume, to-day. Civilization, however, has taken its gigantic strides guided by extra-organic eyes.

Most, if not all the three hundred or more mechanical movements known to mechanics to-day are found exemplified in the human body. From an evolutionary standpoint it is still more important to note that all the machinery in the world, all the bars, levers, joints, pulleys, pumps, girders, wheels, axles, ball-and-socket movements, etc., etc., are but variations, extensions, adaptations of the accumulated advantageous variations and adaptations of the human organism.

Thus our sense organs are indefinitely multiplied and extended by such extra-organic sense organs as the microscope, telescope, resonator, telephone, telegraph, thermometer, etc. Our motor organs are

multiplied by such agencies as steam and electrical machines, etc., in the same manner. The printing press is an extra-organic memory far more lasting and durable than the plastic but fickle brain. Fire provides man with a second digestive apparatus by means of which hard and stringy roots and other materials for food are rendered digestible and poisonous roots and herbs rendered innocuous. Tools, traps, weapons, etc., are but extensions of bodily contrivances. Clothing, unlike the fur or layer of blubber of the lower animal, becomes a part of the organism at will. One becomes more or less independent of seasons, climates and geographical restrictions. Thousands of extra-organic adaptations are being invented (most of them really accidental variations) every day.

Professor J. Mark Baldwin, writing on this question of social heredity, defines it as 'the process by which the individuals of each generation acquire the matter of tradition and grow into the habits and usages of their kind.'* By social heredity I mean not only this, but also the transmission from the parents to the children of the improved environment, more especially of the extra-organic sense and motor organs. By organic heredity I mean, roughly speaking, the transmission of the congenital characteristics of the parents to the children.

By the latter process alone, all progress depends upon the transmission of variations occurring *within* the organism. Thus progress would be, as it has been, indefinitely slow. Moreover, these advantageous organic variations die with the individual, and must be born again, so to speak, with each new individual. This requires time. On the other hand, by means of social heredity each new member of the race has handed to him at birth, not only the accumulated organic advantageous variations of sense and motor organs (animals and the poor inherit in the same way!), but has handed to him the extra-organic adaptations which have multiplied so indefinitely in the age of civilized man. The vast importance of accumulation of capital is obvious.

In this way man's organism is indefinitely extended. He reads Aristotle, and his organism reaches back two thousand years. He reads the latest cable from Australia and Japan, and he listens at the antipodes. With an electric button he accomplishes herculean tasks. There are giants in these days.

The extra-organic part of his organism becomes in many cases as valuable to man as his organic part. Ofttimes for it he will sacrifice his life, as the soldiers throw their lives away on the battlefield to save the gun.

This is obvious and well-known. Such large requirements meeting the individual on the threshold of his life demand a large measure of plasticity. Adaptability to one's new environment is always the mark of high intellectual development. Such adaptability is rendered possible by the nature and growth of the brain. Of the 800 to 1,000 million nerve cells present in the human cortex, all are formed before birth. But all are not developed. Cell elements are present but immature, mere granules, nuclei which do not form a functional part of the tissue. Under certain conditions, however, they are capable of further development. With further growth and exercise nerve fibres appear and form functional systems.

It seems, therefore, that in addition to the cells and fibres connected at birth (and sometimes later), as in instincts, there is a mass of latent or potential nerve cells and fibres which *await connection*. These form probably the physical basis of our acquired (mental) characteristics.

Thus there is rendered possible the speedy

*SCIENCE, April 23, 1897. See also Lloyd Morgan, Habit and Instinct, pp. 340–343.

acquisition of knowledge of the past and new arrangements and adaptations to meet the requirements of a more exacting environment. The latent cells become functional, and new associational paths are formed which become, or may become, by the law of habit, just as fixed and, ontogenetically considered, as reflex, and organic as the most definite inherited reflex action and instinct.

Some such theory as the above seems to be necessary to explain the wonderful advance of modern civilization. It is certainly not explained by any one or all of the three processes mentioned above, namely, those of organic, intra-organic and germinal selection. It may however be considered as a continuation of the same fundamental process. If the organism were forced to evolve within itself, by the slow process of organic selection, all the adaptations necessary for such a civilization as we have to-day, it is obvious that after millions of years it would finally produce a world-colossus, or impossible gigantic monstrosity.

ARTHUR ALLIN.
UNIVERSITY OF COLORADO.

BINOCULAR FACTORS IN MONOCULAR VISION.

ALL experiments in monocular vision have to be made with one eye closed or covered. Some writers have maintained that binocular factors are by no means eliminated under these circumstances, but that the movements of the closed eye yield just the same sensation data as would result if the eye were opened. The following observations may aid in the solution of this problem.

If an observer closes one eye and looks steadily at an object situated in the median plane and at about the same elevation as his eyes, and then suddenly opens the eye that was closed, he will note an appearance of unrest in the object. Careful observation will show that the object seems to shift horizontally in the direction of the eye that was not closed. The shifting in apparent position becomes very noticeable when the eyes are alternately closed. The object will seem to move backward and forward in a horizontal line, always moving toward the eye that has just been closed. If the object is somewhat above the elevation of the eye there will be a vertical movement downward in addition to the horizontal. This apparent change in position may be observed best when looking at distant objects; the stars and moon show it very clearly. It is evident from these facts that the closed eye is not converged toward the same point as the open eye. At the moment of opening the eye there are double images, and these double images are crossed as is shown by the direction in which the object seems to shift. In fact, it is frequently possible to see the double images, and to note that the one which appears when the eye is open is on the opposite side from that eye, that is, crossed. The crossed images indicate that the closed eye is converged beyond the object. When looking at the stars or moon, however, in order to have crossed double images the eyes must be diverged, and the distance which appears between the images makes it evident that the divergence is considerably beyond the position of parallelism.

Helmholtz* and Le Conte† have both observed that when the muscles of the eyes are relaxed in drowsiness there is a tendency for double images, which indicates divergence of the axes, to appear. Le Conte has expressly noted that the degree of divergence is so great that the axes must be considerably beyond the parallel position. Evidently the facts observed when one eye is closed are related to those which appear in drowsiness. The closed eye tends to

* Physiol. Optik 2te Aufl., p. 633.

†Amer. Jour. of Sc. and Arts (3), ix., p. 160.

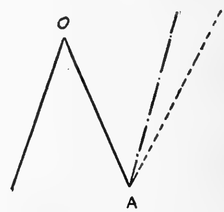
relax and in this relaxation diverges somewhat.

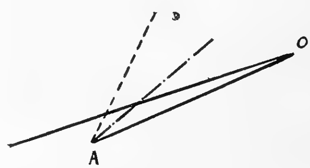
The observations here described have been confirmed by a number of persons. Only one case appeared in which the results were different. In this case, however, one eye is not normal in its vision and in drowsiness, as well as under the conditions discussed convergence rather than divergence was regularly observed.

The degree of divergence is difficult to determine, as the double images last only a very short time, the convergence adapting itself very soon to the object. The phenomena described appear most strikingly in the case of very distant objects, that is, where the optical axes were at the start parallel. On the other hand, where there is an effort required in the original convergence, strong enough to give a clearly conscious impression, the closed eye does not seem to relax as much. The degree of relaxation in the closed eye seems, in general, to be inversely proportional to the degree of effort required to maintain the original convergence.

The conditions may be modified so that relaxation shall result in convergence rather than in divergence. Take an object situated so far from the median plane that the opposite eye can just see it over the root of the nose. Suppose, for example, that the object is on the right. If now the right eye be closed, while the object is fixated with the left, and then be suddenly opened, it will be observed that the double images are not crossed. This indicates that the eyes are converged to a point nearer than the object. Care must be taken in this experiment to fixate the object with the left eye. If the object is seen in indirect vision the conditions are, of course, modified.

The only inference possible from these two sets of facts is that there is some line situated between the parallel and extreme lateral positions of the optical axes towards which the closed eye tends. Le Conte has surmised: "It is probable that in a state of absolutely perfect relaxation the optic axes coincide with the axes of the eye-sockets, and it requires, therefore, some contraction to bring the optic axes to a condition of parallelism and still more to a condition of convergence, as in every voluntary act of sight."* This surmise seems to be confirmed by the facts described and by the additional fact that a certain angle can be found between the position of parallelism and the extreme lateral position at which there is no tendency for the eye to change the degree of its convergence when closed. This angle corresponds with the angle of the axes of the eye-sockets. But in any case the tendency of the closed eye to diverge is checked when the effort towards convergence is strong enough to be noticeable.





The two figures will make clear the fact. The dotted lines represent the axes of the eye-sockets towards which the eyes tend to

* Loc. cit., p. 161.

turn when closed. The mixed lines show the actual direction of the eyes when closed and at the instant of opening. The complete lines show the direction of the axes of the eyes when open. *A* represents in both cases the eye closed, *O* the object.

There is one case which offers some difficulty to this explanation; unless, indeed, it is to be regarded as an illustration of the general principle formulated above that relaxation is inversely proportional to the effort of convergence. If, as in the instance represented in the second figure, the object be far to the right, but be fixated with the right eye rather than with the left, and then the left eye be closed and opened, we should naturally expect crossed images indicating convergence beyond the object. I have sometimes found this to be the case. Sometimes, however, I have observed no double images, or even at times uncrossed double images. It would seem that in these cases the closed eye in its strained position may be converged too much. This, however, is observable only at times; the regular results are double crossed images.

So far as convergence is concerned the open eye exerts the controlling influence; its position remains unchanged. But in accommodation the relaxation of the closed eye has an important influence on the accommodation of the open eye. If an object is fixated with both eyes, and moved away to the limit of distinct vision, it will be found on closing one eye that the outlines are no longer distinct. It is, for example, impossible to read print with one eye at a distance to which it could be just clearly seen with both eyes open. The figures on the moon grow very indistinct when one eye is closed. This indistinctness may be due, in part, to the enlargement of the pupil, for the pupil of the open eye is very much enlarged in sympathy with that of the closed. But this cannot be the whole explanation. For when one eye is covered up in such a way as not to exclude the light entirely the pupil of the fixating eye is not affected as much. The outlines, however, are indistinct even in this case, showing that the accommodation of the lens has undergone a change. Whether this change in the lens is one resulting in greater or less convexity I have not succeeded in determining. The fact that a voluntary accommodation for a nearer point does not, in my case, make the object clearer, but rather the contrary, would seem to lead to the conclusion that the lens has become more convex rather than less so. Yet this does not appear to be conclusive. The main fact, however, is that there is some change in the accommodation of the lens of the open eye when one eye is closed.

The bearing of these facts on many experiments in optics will be apparent. Wundt denies complete binocular convergence when one eye is closed, while Hildebrandt and Arrer* maintained the opposite. The truth seems to be that the closed eye follows the open eye to a certain extent, and to a certain extent obeys its own tendencies of relaxation. There is a change in the size of the pupil in both eyes and a change in the accommodation of the lenses.

CHAS. H. JUDD.
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A NEW NAME FOR THE NOVA SCOTIA FOX.

IN the proceedings of the Biological Society of Washington, Vol. XI., March 16, 1897, pp. 53–55, I described the large red fox that occurs in Nova Scotia (and perhaps other parts of the Canadian and Hudsonian zones in eastern North America). Unfortunately, I used the subspecific name *vafra* that is already in use for a fossil fox —the *Canis vafer* Leidy (Ext. Mam. Faun. 1869, p. 368).

It therefore becomes necessary to re-

*'Philosophische Studien,' XIII., p. 116 seq. Other references given in the same place.

name the Nova Scotia animal, and I propose to call it *Vulpes pennsylvanica rubricosa* (Type No. 116, Bangs Coll.; described under above reference as *Vulpes pennsylvanica vafra*).

OUTRAM BANGS.

JANUARY, 1898.

THE AMERICAN CHEMICAL SOCIETY.

THE sixteenth general meeting of the American Chemical Society was held with the Washington Section on December 29th and 30th. No place could have been more favorable for the meeting, as, outside of New York, Washington has the largest and strongest local section of the Society. As a result, this was the most largely attended meeting in the history of the Society. Every preparation had been made by the local committee and no meeting has been more successful or enjoyable. The sessions were held at the Columbian University and were opened by an address of welcome by President B. L. Whitman. The forenoons and Wednesday evening were devoted to the reading and discussion of papers. Among the papers read were the following:

Professor L. P. Kinnicutt, of Worcester, gave an interesting account of recent developments in the new methods of sewage purification, including the method by which a very considerable amount of the purification is due to giving the anærobic bacteria an opportunity to develop to the greatest extent.

An account was given, with illustrations, of Professor W. O. Atwater's respiration calorimeter, by means of which the total income and expenditure of heat and energy of the human body can be measured for periods of several days at a time.

C. A. Crampton, of the Treasury Department, read a paper on glucose in butter, illustrated by samples. Glucose is largely used as a preservative for butter to be shipped to tropical climates. The peculiar taste of some peoples was well illustrated by a sample of butter prepared for the island of Martinique, which was a bright orange-red color. Mr. J. P. Geisler, of New York, showed that the azo dyes which are used for coloring butter are very readily detected by absorbing with fuller's earth.

In the field of analytical chemistry Professor Francis C. Phillips read a paper on the determination of sulfur in gas-mixtures, giving description and illustration of an apparatus in which any desired amount of a gas (as natural gas) can be burned and the sulfur estimated as barium sulfate.

There was but one paper on didactic chemistry, by Professor Wm. P. Mason, of the Troy Polytechnic. In the very earnest discussion which followed the paper this question was raised: Is it wiser for a teacher to state scientific theories to his class dogmatically, thus giving them something tangible for a foundation, but knowing that, as they progress, they will have much to unlearn and modify; or should he confine himself strictly to statement of known truth, discussing conflicting theories with their arguments, pro and con, and, as a result, leave the mind of the student in a very hazy condition? It is not in chemistry alone that this difficulty arises.

Of papers devoted to pure chemistry, mention may be made of a series of papers on physical chemistry from the Cornell University laboratory; a discussion of the compounds of the higher haloids of elements of the Group IV., by J. F. X. Harold, of the University of Pennsylvania; a paper on the atomic weight of zirconium, by Professor F. P. Venable, of the University of North Carolina, and one on the chemistry and crystallography of some new rutheno-cyanids, by Jas. Lewis Howe and Professor H. D. Campbell, of Washington and Lee University.

President Charles B. Dudley's address on

Wednesday night was on the Dignity of Analytical Chemistry, and was a strong plea for this field from the standpoint of pure chemistry and has already been printed in this JOURNAL.

The election of Dr. Charles E. Monroe, of Washington, as President of the Society for the ensuing year was announced.

Thursday night was devoted to a banquet given by the local section at Maison Rauscher's, which was attended by nearly three hundred. President W. D. Bigelow, of the local section, presided, and Dr. H. Carrington Bolton acted as toastmaster. Among many notable speeches, a poetical effusion by Dr. H. W. Wiley, of the Agricultural Department, was perhaps the best appreciated.

Washington is so full of places of interest to the American citizen as well as to the chemist that considerable time was given to sight-seeing. The members were received by President McKinley at the White House; the various department laboratories were visited, as well as many other government buildings; a special excursion was given to Mt. Vernon, Friday morning, returning to Fort Meyer to witness the Cossack drill in the afternoon; and, perhaps not least in the estimation of many of the chemists, the great Heurich brewery was fully inspected and a bountiful collation in German style was partaken of. Finally, the courtesies of the Cosmos Club, which was made almost a rendezvous for the Society, added much to the enjoyment of the meeting.

J. L. H.

CURRENT NOTES ON PHYSIOGRAPHY.

SPECIAL FEATURES OF DISSECTED PLATEAUS.

PLATEAUS of horizontal strata, maturely dissected, offer a great number of variations upon simple types of hills and valleys; no two hills being alike, yet all having a strong family resemblance. The student soon passes from these widely prevalent forms to local examples of special features, which then receive an amount of attention quite out of proportion to the area that they occupy, but highly appropriate to their peculiar evolution.

C. F. Marbut describes some local forms of this exceptional kind in Missouri (Cote Sans Dessein and Grand Tower, Amer. Geol., XXI., 1898, 86–90). A short distance upstream from the fork of two streams the widening of their graded valley floors occasionally results in the lateral abstraction of the smaller stream by the larger one. An isolated hill or group of hills is then left between the forked valleys below the new cut-off. An example that bids fair to become typical for this country occurs in Benton County, Mo., where the town of Warsaw lies on the margin of one of these hill-groups, in the (former) fork of the Osage and the Grand River valleys. Three miles above the former junction of these streams the outward cutting of their meanders has worn through the dividing ridge, and has thus tempted the Grand to enter the Osage and desert its lower course.

'Cote Sans Dessein' is described as the narrow remnant of a hill-group of this kind, once included in the fork of the Missouri and Osage, but now reduced to a narrow isolated ridge a mile long and 200 feet wide, rising above the Missouri flood-plain. The name given to this ridge by the early *voyageurs* reminds one of the early naturalists and their 'queer fish,' now the treasure of the zoological evolutionist.

ARTESIAN WELLS OF COASTAL PLAINS.

THE artesian well should take high rank as a characteristic of the normal coastal plain. Simple structure consisting of discrete or of slightly indurated strata; decreasing relief and variety of form from the old shore line to the new; low-grade rivers extended from the old land, often deltaless

and open-mouthed by slight submergence; off-shore sand reefs, with inlets and off-sets; agriculture and forestry, rather than mining and manufacturing, as industries—to all these a good artesian supply of water is an important additional feature, especially to the towns on the low and smooth littoral plain and to cities on the shore or on the off-shore sand-reefs.

'Artesian well prospects in the Atlantic coastal plain region' is a timely summary, by N. H. Darton (Bull. 138, U. S. Geol. Surv.), of our present knowledge on this subject. It gives much encouragement for the future. A number of colored maps and corresponding sections make the report easily understood. The location of successful and unsuccessful wells is conspicuously shown. Repeating the curious example, already described by Darton, of wells in eastern Maryland supplied by water-bearing strata (aquifers) that pass under Chesapeake bay, we here find wells about Norfolk fed by aquifers that pass beneath the saline estuaries of southeastern Virginia. The greater amount of detailed knowledge concerning the well prospects in New Jersey than in the Southern States is a tribute deservedly earned by the New Jersey Geological Survey.

DRUMLINS IN NORTH GERMANY.

K. KEILHACK, of Berlin, describes a 'Drumlinlandschaft in Norddeutschland' (Jahrb. k. preuss. geol. Landesamt, 1896 [1897], 163–198), from which it appears that an extensive group of well defined drumlins lies east of the lower Oder, between the Baltic sea and one of the terminal moraines of that glaciated region. The hills, illustrated by a number of detailed maps, are of moderate height, with ratio of 2½ or 3 between length and breadth; some of them being elongated ridges, three or four kilometers in length. Their distribution, indicated by diagram and map, is of especial value in a region where glacial striæ are rarely seen; for their axes show as ympathetic parallelism in a curving arrangement that strongly indicates a glacial flow toward the free morainic border near by. Now that drumlins have been found on the northern piedmont of the Alps by Sieger and Früh, in Sweden by de Geer, and south of the Baltic by Doss and Keilhack, they need not be regarded as such rarities in continental Europe as they were thought to be fifteen years ago.

THE VERNAGT GLACIER.

THE Vernagt glacier in the eastern Alps, famous for its flood-like advances into the Rofen valley (1599, 1680, 1773, 1845), and for the disasters caused by the outbreaks of the impounded valley stream, is made the subject of accurate measurement and description by Dr. S. Finsterwalder, of Munich; his monograph forming the first 'scientific supplement' to the Zeitschrift of the most flourishing of all Alpine clubs, the German and Austrian Alpenverein (Graz, 1897). The history of the glacier and the earlier maps of its form are carefully reviewed. A detailed account is given of the author's survey, the result being presented on a most beautiful map in several colors, on a scale of 1 : 10,000, with contours every ten meters. Then follows a discussion of the conditions of glacial motion, as here exemplified, and finally a consideration of the outbreaks of this remarkable glacier; their cause being ascribed to variations of snow and névé supply in the irregular upper reservoir. A special study follows on the end of the glacier in 1891, '93 and '95, by Blümcke and Hess.

W. M. DAVIS.

CURRENT NOTES ON ANTHROPOLOGY.

QUIPU READING.

IN the *Bulletin* of the Free Museum of Science and Art, Philadelphia, for December, 1897, Dr. Max Uhle has an article on

a modern quipu (his orthography is *Kipu*) from Bolivia. This one is not the same which he described in the *Ethnologisches Notizblatt*, of Berlin (referred to at that time in these notes). He obtained it from a native on a hacienda near Lake Titicaca, and its purpose was to keep the tally of the sheep, rams, ewes and lambs entrusted to his care. Others are used for reckoning the harvest and rendering accounts of various kinds. These are usually white in color only, and the count is registered by knots. Quipus of various colors are probably still in use, though Dr. Uhle was unable to secure specimens. He discusses four ancient and modern authorities on the significance of the hues, and believes that by further research we shall be able to extend our knowledge greatly of this curious method of recording facts.

ETRUSCAN STUDIES.

A WRITER somewhat well known for his archæological essays, Guiseppe Fregni, published last year a study of some of the leading Etruscan inscriptions, with what he alleges are translations (Delle più celebri Iscrizione Etrusche, p. 155, Modena, 1897). It is well illustrated and presents with care copies of eight or nine of the longer inscriptions and a discussion of the alphabet and its variants.

To the learned author the Etruscan problem is child's play in the simplicity of its solution. He allows himself humorous flings at the erudite obtuseness of previous students. All you have to do is to read the inscriptions in any or all of the Italic dialects, taking the words now in one, now in other, and, if they don't fit, cutting them up or expanding them, to make them fit, and calling in the Greek or Phœnician when the Italic dialects are wholly refractory. To be sure, they could be read, according to this method, just as well in English or Dutch or Choctaw; but this objection the author does not take into consideration. He presents complete and fluent renderings of all of them.

THE HUICHOLA TRIBE.

AN interesting collection of ethnographic objects has been brought by Dr. Carl Lumholtz from the Huichola Indians. They dwell in an extremely mountainous part of western central Mexico, and are rarely visited by white men. They are pagans, though retaining some faint traces of the Christianity taught them in the last century by the Jesuits and Franciscans. Much of their ritual is occupied with 'rain-making,' and their symbolism is markedly aboriginal in spirit. The sacred plant *peyotl*, so common in the native rites throughout Mexico, and prized for the intoxication it produces, is held in high esteem among them.

The Huichola language has generally been considered a dialect of the Uto-Aztecan stock, and perhaps in them we may recognize some of the ancient 'Chichimecs.' Dr. Lumholtz has published some account of his researches in the last number of the *Bulletin* of the American Museum of Natural History.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

SATISFACTORY reductions in blowpipe analysis are often attended with more or less difficulty, as, for example, the reduction of tin oxid or barium sulfate. In the last *Zeitschrift für anorganische Chemie* a new method is proposed by Professor Walther Hempel, which he claims obviates many difficulties. A very small piece of metallic sodium is flattened out on a small piece of filter paper, and the substance to be examined is rolled up in this and wound with a close spiral of finest iron wire. After the excess of paper is cut off, the roll is slowly burned in the interior of a Bunsen flame and cooled in the stream of gas close

to the top of the burner. The product is then treated with a little water in an agate mortar, when the caustic soda formed is quickly dissolved and any metal present is left, generally in quantity large enough for easy examination. Sulfur and other substances are very readily detected in the solution. In case of silicates and borates the silicon or boron is left in the elementary state and easily recognized. In case it is desired to examine the constituents of the substances with the spectroscope, aluminum or magnesium filings are substituted for the sodium. The reaction is violent, but in small quantities unattended by danger. If it is desired to use larger quantities the substance must be diluted with an indifferent body, as salt when sodium is used, magnesium oxid with magnesium and aluminum oxid with aluminum. In this way considerable quantities may be used in a small iron crucible, and thus silicates decomposed in a few seconds. With care the process is even available for quantitative work.

In the course of an investigation on the analysis of illuminating gas, Messrs. Harbeck and Lunge have discovered the existence of a stable compound of carbon monoxid with platinum and also with palladium. These are formed by leading carbon monoxid over the metal in a finely divided state. The metals are not completely converted into the carbonyl, hence their composition is as yet unknown, but they present an analogy to the volatile carbonyls of nickel and of iron. They have no catalytic power of causing the combination of gases, and their formation explains why the presence of carbon monoxid prevents the catalytic action of platinum and palladium. As it is well known that certain other gases also prevent this catalytic action, investigation will now be needed to see if they too form similar compounds.

In a paper read before the Chemical Society (London), Messrs. Lean and Whatmough discuss the preparation of pure iodin. It is well known that iodin is very difficult to prepare free from bromin and chlorin. The authors find that cuprous iodid can readily be prepared free from these elements, and by heating it in a stream of dry air at 220°–240° most of the iodin is expelled and can be condensed upon a cold surface. This pure iodin has a black vapor and not the usual deep violet, thus confirming the statement of Stas that the vapor of pure iodin is opaque. Further, it emits no visible vapor at ordinary temperatures.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

The Senate confirmed, on February 14th, President McKinley's appointment of Mr. George M. Bowers as Fish Commissioner.

The Prince of Wales has consented to act as patron of the coming International Congress of Zoology.

Professor Agassiz arrived in San Francisco on February 13th on the steamship *Australian* from Honolulu, returning from his investigations of the formation of coral islands.

Professor Luigi Cremona, who holds the chair of mathematics in the University of Rome, has been elected a correspondent of the Paris Academy of Sciences.

The Senate of Glasgow University has appointed Professor Michael Foster, secretary of the Royal Society and professor of physiology in Cambridge University, to be Gifford lecturer in the Glasgow University in succession to Professor Bruce.

Dr. Nansen is now giving lectures in Great Britain, and will next month lecture in St. Petersburg and Vienna. He then expects to return home and devote himself to studying the specimens collected and the observations made during his expedition.

The Cameron prize of the University of Edinburgh has been awarded to Professor T. R. Frazer for his researches in practical therapeutics.

THE death is announced of Dr. Samuel Newth, the author of text-books in physics and mathematics, and formerly Principal of New College, near London.

A BRASS tablet has been placed in the biological laboratory of Johns Hopkins University, in memory of Professor Humphrey and Mr. Conant, who died in Jamaica last summer. It bears the following inscription: "In memory of two devoted naturalists, who gave their lives to promote science, James Ellis Humphrey, associate professor of botany in this University, died in Jamaica, August 17, 1897, at the age of thirty-five years; and Franklin Story Conant, Bruce fellow in this University, died from illness contracted in Jamaica, September 13, 1897, at the age of twenty-seven years. The heart of him that hath understanding seeketh knowledge."

THE managers of the Royal Institution, London, have resolved that the centenary of the Institution (founded in 1799) shall be properly celebrated next year.

THE botanical collection recently formed at St. Mungo's College, Glasgow, by Dr. James Swanson, professor of botany, has been increased by a large number of specimens presented by Mr. F. W. Moore, Director of the Botanical Garden, Glasnevin, Dublin.

THE Biological Club of Princeton University has sent, through Senator Sewall, a protest against the bill interfering with physiological and pathological experiments in the District of Columbia that has been introduced into the Senate. Such protests have been sent by a number of scientific societies and should be neglected by none.

THE Ornithologischer Verein of Vienna has been merged into the K. K. Zoologisch-botanische Gesellschaft of that city, as an ornithological section of the Society. The Ornithological Section of the Zoological Society will retain the observation stations. A great number of them will keep a record of the migration of birds; materials will be collected for the study of birds' food, birds' usefulness and destructiveness. The result of the work at the different observation stations will be published in reports, which will be issued from time to time. The quarterly journal of the Ornithologischer Verein, *Die Schwalbe*, will be discontinued; Volume XXIV., No. 4, being the last number.

IT was arranged to devote the meeting of the Royal Society of February 24th to a discussion of the scientific advantages of an Antarctic expedition opened by Dr. John Murray.

THE fifth annual reception and exhibition of the New York Academy of Sciences will be given at the American Museum of Natural History, on Wednesday and Thursday, April 13th and 14th. The first evening will be devoted to a reception to the members of the Academy and their personal friends. On the afternoon of the second day the exhibition will be open to students and others, and in the evening to interested friends and affiliated societies in New York City. Professor George E. Hale, of the Yerkes Observatory, will also give the annual lecture before the Academy on that evening. The committee having the exhibition in charge are Messrs. Henry F. Osborn, Charles F. Cox, Reginald Gordon, Gary N. Calkins and Richard E. Dodge, chairman. Scientific workers having materials showing progress in science during the last year that they might wish to exhibit should correspond with the chairman of the committee, Professor Richard E. Dodge, Teachers' College, 120th Street, West, New York City.

PROFESSOR J. M. SCHAEBERLE writes to the *Astronomical Journal* that a cable dispatch received at Mt. Hamilton from Professor Campbell, who is in charge of the Crocker Lick Observatory Expedition at Jeur, India, states that most satisfactory photographs of the corona were obtained with three different telescopes. One set with a telescope 40 feet long, and two other sets with five-foot and three-foot telescopes. He also reports that the great equatorial extension of the corona, which formed such a conspicuous feature of the eclipse of January, 1889, has again been photographed. He also satisfactorily photographed the changes in the solar spectrum at the sun's edge with the aid of one of the spectroscopes, and probably obtained successful photographs of the reversing layer with the aid of a second spectroscope.

MR. F. H. KNOWLTON has just completed the manuscript of a 'Catalogue of the Cretaceous

and Tertiary Plants of North America,' embracing 2,652 species and varieties. In 1876 Professor Leo Lesquereux published a catalogue of similar scope, but at that time only 706 species were known, which shows that the knowledge of our fossil floras has increased rapidly within the past twenty years. The Catalogue will be published as a Bulletin of the U. S. Geological Survey.

THE *Moniteur Industriel* of January 29th states that the objections to wood as a pavement are appearing in very noticeable ways in Paris, and have been observed for a long time. Recently, the unhealthy and nauseating surface moisture and deposits have become so objectionable that it has been decided to endeavor to find a remedy. The men repairing the payment have been subject to epidemic illness. Cement will probably be used to cover the surface of the pavement in some cases, experimentally at least. Creoline is used as a disinfectant, meantime, and is said to have proved quite unsatisfactory. In cases of analysis by Drs. Miquel, Rodet and Nicolas, from 17,000 to 50,000 microbes have been found in a gramme of the deposit from the surface of the pavement. Asphalt blocks are recommended in substitution, and it is proposed that all wooden pavements within the city limits be removed.

THE Baldwin locomotive works, of Philadelphia, have received an additional order from the Russian government for fourteen locomotives, making in all thirty-four locomotives now in course of construction for the Russian government.

TROUT have been successfully introduced into the streams of Australasia, and the Government of New Zealand is now importing a large number of salmon over from Great Britain.

THE certificate of incorporation of 'The Thomas W. Evans Museum and Institute Society' has been filed in Philadelphia, the board of trustees consisting of leading citizens. It will be remembered that Dr. Evans left the larger part of his estate for the foundation of a dental institute to be located in West Philadelphia. Philadelphia is already well supplied with schools of dentistry, and it seems probable that this large sum of money, said to be about $4,000,000, will not be used to the best possible advantage, even supposing it be not divided among the lawyers.

THE following resolution was unanimously adopted at a meeting of the New York Academy of Medicine on February 17th: "*Resolved*, That the Fellows of the New York Academy of Medicine do earnestly recommend the establishment of a Bureau of Health, with the power to administer within constitutional limits the sanitary needs of the United States. The New York *Evening Post* advocates the measure, devoting to it an editorial, a column and a-half in length, in the course of which it says: "One of the most urgent needs of this country to-day is the establishment of a National Health Bureau, of which a supervision and harmonizing of quarantine procedures might well be a function, but by no means the most important one. To turn into useful channels, without delay, facts which patient toilers in science are daily bringing to light; to prosecute research in new fields of promise for the physical welfare of the citizens; to create a standard for public sanitary measures; to harmonize, and, when called upon, to direct such measures in different States; to investigate the great and growing problems of public water supplies which touch upon many fields involving the individual rights of associated States of the Union; to secure international cooperation in guarding or suppressing the centers of distribution of infectious material the world over; to collect statistics of disease and render available the fruitful lessons which they bear; to hold in readiness the machinery for the suppression of epidemic disease when called upon by stricken communities—these are some of the urgent functions of a National Health Bureau, whose organization cannot too soon be under way."

SECRETARY LONG has recommended that the corps of naval professors of mathematics be discontined as part of the naval establisment. His recommendation is accompanied by the following memorandum: "The reason for the creation of the office has passed away. These professors were, at first, teachers of midshipmen on board ship, and were thus exposed to the dangers of service in war and at sea. They

were, therefore, properly pensioned by a place upon the retired list. To-day their name is largely a misnomer. Under the law, one is assignable to the teaching of ethics and English studies, one of Spanish and one of drawing. In fact, only one teaches mathematics at the Naval Academy; several of them are on duty at the Naval Observatory; two are librarians; one is engaged in ordinance work, and another in the bureau of yards and docks. They have no service at sea, and there is no more reason why hereafter the retired list should be open to a new appointee to the work now done by this corps than to any other employee in civil life. If this recommendation is adopted by Congress it will be necessary to provide for the appointment of astronomers at the Naval Observatory, to take the places, as they shall become vacant, of existing professors of mathematics who now serve in that capacity. There should be five astronomers, as at present, and the salary of those hereafter appointed should be sufficient to make up for the refusal to them of the privilege of retirement, and also to secure men of high scientific attainments, adequate to the demands of one of the most capable observatories of the world. As the above astronomical corps is now full, no appointment under the new statute proposed will be necessary till a vacancy occurs."

Nature states that a meeting will be held in Manchester on February 16th to take into consideration such steps as may seem desirable to assist the executive committee in making the Zoological Congress this year thoroughly successful.

THE Physical Society of Paris has undertaken the supervision of a 'Bibliographica Physica' and has appointed a commission to arrange a method of bibliographical classification. The Physical Society and the Institute of Electrical Engineers, of London, are arranging for the publication of abstracts and papers.

MESSRS. MUNN & CO. have issued a reference catalogue containing a classified index of more than 10,000 articles that have appeared in the *Scientific American Supplement* since its establishment in 1876. The publishers offer to send the catalogue without charge, and it will prove of value to those who wish to consult any of the large number of valuable scientific articles that have been included in this publication.

UNIVERSITY AND EDUCATIONAL NEWS.

THE British government has expressed itself in favor of a Catholic University for Ireland, though it is not expected that any active steps towards its establishment will be undertaken during the present session of Parliament.

A BILL has been introduced in the lower house of the Prussian Diet giving the Minister of Education power to reprimand or withdraw the licenses of *Privatdocenten*. The bill is evidently intended to give the Government power to regulate the teaching of the lecturers, and has aroused much opposition, a protest against the measure having been signed by one-half of the professors in the University of Berlin.

THE Baldwin locomotive works of Philadelphia has presented the department of mechanical engineering of Columbia University with the locomotive exhibited at the World's Fair valued at about $12,000. Within the past few months donations of machinery to this department have been made valued at $60,000.

PROFESSOR LESTER F. WARD will give two courses of lectures, one on pure sociology and one on applied sociology, at the University of West Virginia during the summer quarter.

DR. KARL HÜRTLE has been promoted to a full professorship of physiology at the University of Breslau, and Dr. Anschütz to a full professorship of chemistry at the University of Bonn. Dr. Wiechert has been appointed associate professor of terrestrial magnetism in the University of Göttingen, and Dr. Eugen Meier, of the Polytechnic Institute of Hannover, professor of technical physics in the University of Göttingen.

DISCUSSION AND CORRESPONDENCE.

PRESIDENT MC'KINLEY'S APPOINTMENT OF A FISH COMMISSIONER.

TO THE EDITOR OF SCIENCE: Under the head of 'Scientific Notes and News,' the last number of SCIENCE contains remarks concerning the President of the United States which are unjust, untrue and malicious, and which as an associate

editor I disclaim. I beg, therefore, that you publish this letter in the next issue.

J. W. POWELL.

BUREAU OF AMERICAN ETHNOLOGY,
WASHINGTON, D. C.

[In view of this letter and of others that have been received it is to be regretted that the note in question was admitted, especially without the signature of the writer. Leading newspapers that have supported President McKinley, such as the Philadelphia *Ledger*, the New York *Evening Post* and the Boston *Transcript*, have characterized his action in the appointment of a Fish Commissioner as weak and illegal, and it was supposed that this point of view would be shared by all men of science, however fully they might in other respects support the present administration.—ED. SCIENCE.]

A CHARACTER REGULARLY ACQUIRED BUT NEVER INHERITED.

ONE cause of the conflicting testimony concerning the inheritance of acquired characters is the difficulty of deciding whether a new or abnormal structure appeared in the individual after birth through a somatogenic change, or whether it was due to a prenatal or blastogenic variation. Whatever value we may attach to the present case, it is certainly interesting and avoids any difficulty of this kind.

The sternum of heavy perching birds belonging to the order Gallinacei, which includes the domestic fowl, the turkey and their wild ancestors, as well as the grouse, has the well-known keel shape, and for some months after birth is semi-cartilaginous, and therefore soft and yielding. The keel is applied like a blunt knife edge to the hard perch. The transverse line of pressure caused by the weight of the body not supported by the legs soon produces a deformity which lasts for life. A cushion-shaped enlargement may be formed, or the keel may be bent or twisted in a variety of ways. Some such deformity is inevitable from the mechanical conditions present. Moreover, this has been taking place not merely for a few generations, but during the whole course of the later evolution of these animals. At the end of each generation the individual variations thus acquired are completely effaced, and the young always begin life with the sternum normal.

The keel of the sternum in carinate birds has apparently arisen in correlation with the pectoral muscles concerned in flight, and if we assume that the variations which led to the keel were of a blastogenic character the inheritance of somatogenic changes which deform this structure could not at the same time have occurred. The keel has attained its present form, that of a thin vertical plate, in spite of those somatogenic changes in the life of the individual which tended to flatten and deform it.

No direct evidence that mutilations or deformities of a somatogenic nature are inherited has yet been obtained, and the theoretical improbability of such occurrences is very great. The fact that many animals preserve a characteristic form and symmetry from age to age, and even from one geological epoch to another, is evidence that somatogenic characters are not inherited and cannot be. It is well known that certain decapod Crustacea, such as some of the common crabs and the lobster, practice self-mutilation or autotomy. Here a special mechanism has been developed in the large cheliped by the action of which it is cut off in a certain way and at a definite place. When the large claw is seized by an enemy it is quickly amputated by the twitching of certain muscles stimulated by reflex nervous impulses, and a new limb in time grows out in place of the one cast off. The Lamarckian principle does not help us much in this case, nor in supposing that the germ cells in some mysterious way register every somatogenic change, even if this is not exactly reproduced in succeeding generations.

FRANCIS H. HERRICK.

THE THIRD INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

TO THE EDITOR OF SCIENCE: The organization committee of the Third International Congress of Applied Chemistry, which is to be held in Vienna during the coming summer, has fixed the date of the meeting from the 28th of July to August 2, 1898. Some time during the month of February programs and announcements will

be sent to all persons who have been enrolled as members of the Congress.

H. W. WILEY,
Chairman of American Committee.
U. S. DEPARTMENT OF AGRICULTURE.

ELIZABETH THOMPSON SCIENCE FUND.

ON February 14th last, at the twenty-third meeting of the Board of Trustees, the following new grants were made :

No. 79. $250 to Professor Gustav Hüfner, Tübingen, Germany, for the investigation of hæmin and hæmatine. Application No. 743.

No. 80. $288 to Professor Carlo Bonacini, Modena, Italy, for researches in color photography. Application No. 741.

No. 81. $250 to Professor John Milne, Newport, I. W., England, to aid in a seismic survey of the world. Application No. 750.

Signed :
CHARLES S. MINOT,
Secretary.

SCIENTIFIC LITERATURE.

Text-book of Physical Chemistry. By CLARENCE L. SPEYERS, Associate Professor of Chemistry, Rutgers College. New York, D. Van Nostrand Company. 1897. 8vo. Pp. vii + 224. Price, $2.25.

"I have adopted the view that matter is a collection of energies in space, considering the relations of the energies to be the prime object of investigation. With Ostwald, I feel confident that the materialistic interpretation has passed its prime and has no promise in the future. Still, as this is a text-book, I give the prominent materialistic views of the present time."

These words, taken from the author's preface, make frank avowal of his scientific creed and indicate the point of view from which he proposes to discuss his subject.

Physical chemistry he defines as 'the science which has for its object the investigation of chemical changes by physical methods.' Concerning matter he says: "That which *seems* to cause a direct excitement of our senses we usually call matter." The italics are in the original. And again, "* * * we can define the different forms of matter as collections of forms of energy in space. This definition is free from any speculation; it rests on experimental evidence alone."

Speaking of the seventy-five elements, or, as he terms them, 'collections which do not separate into other collections,' the author says: "We cannot, however, believe that all the seventy-five collections will ultimately be reduced to one or more single separate forms of energy, because in that case we should have nothing left to account for the collection of forms of energy in space. We need energy and a something to enable energy to collect in space before we get a material substance. This something which enables, and perhaps causes, the energy to collect in space we shall call matter. The dissimilarity in the innumerable substances known to us come from the differences in the natures and proportions of the forms of energy collected in space."

Quotation from the work has been made at such length, because, by so doing, the peculiar attitude of its author towards matter and energy could be most clearly depicted.

Undoubtedly in close sympathy with the 'ultra-dynamists,' he nevertheless does not seem wholly prepared to abandon entirely the idea of matter, matter, that 'something which enables, and perhaps causes, the energy to collect in space.'

The topics considered in this volume are: some general remarks on energy, gases, heat, physical changes, equilibrium, chemical kinetics, phases, electro-chemistry, ions.

The order in which these themes are presented appears, to a certain extent, haphazard, as if selected at random. For instance, in spite of the author's introductory lines to his final chapter: "In these last pages we consider some properties of the ions which do not seem to fit in elsewhere," it seems difficult to understand why these properties, alluded to here, were not discussed in connection with the rest of the subject which received full and deliberate treatment in the preceding chapter on electro-chemistry.

As to the manner of treatment accorded to various themes, this may be but the natural outcome of the policy pursued by the author, who in his preface states that he has not attempted to give an historical development of

any subject, but has presented the same "in what I thought the clearest way, sometimes adopting one person's view in one part of the subject, another's view in another part, and, perhaps, my own in still another part."

While this method of procedure unquestionably endows the book with an individuality all its own, the wisdom of adopting such a course, especially in a book intended for 'self-instruction * * * as well as for class-room use,' may well be gravely questioned.

The language employed is, as a rule, clear and to the point, if, at times, unconventional. In some instances, however, the author's meaning is not readily gathered from his statements. Thus, note the second sentence of the following paragraph (p. 61): "There is another way of getting at the molecular weight, which we shall merely state. The theoretical relations are too physical to justify attention in this book." The calculus is freely used in the discussion and elucidation of formulæ and equations; the numerous problems and examples found throughout the book form a valuable feature. Typography and paper are excellent.

The author certainly does not lack confidence in his own judgment and evidently has the courage of his convictions. Thus he says (p. 177): "But in chemical action we meet only heat, light, electricity, mechanical energy or some other well-known energy. So the assumption of chemical energy is strictly gratuitous and not to be advised at all."

The kinetic theory of gases seems to have incurred his special displeasure. He writes (p. 20): "The kinetic theory is a troublesome thing and is becoming an object of ridicule. It has never directed the chemist to any new discovery or idea, unless it may be Van der Waal's theory, and that would probably have come any way." And again (p. 22), in referring to Van der Waal's theory: "Originally derived from the kinetic theory of gases, it has nevertheless none of the absurdities of that theory and will not fall with it."

Contrast with this the words of Sir William Thomson on the same theory ('Popular Lectures and Addresses,' Nature Series, Vol. I., p. 226): "A little later we have Daniel Bernouillis' promulgation of what we now accept as a surest article of scientific faith—the kinetic theory of gases."

Evidently the views of Lord Kelvin will have to undergo a radical change if they are to conform to those of our author.

FERDINAND G. WIECHMANN.

Bibliography of the Metals of the Platinum Group, 1748–1896. JAMES LEWIS HOWE. Published by the Smithsonian Institution. 1897. Pp. 318.

Professor Jas. Lewis Howe, whose initials are familiar to all who read the well selected 'Notes on Inorganic Chemistry' contributed to SCIENCE, has placed chemists under a debt of gratitude by a carefully edited volume with the above title. It forms an index to the literature of platinum, palladium, iridium, rhodium, osmium and ruthenium from 1748 to 1896; so extensive is this literature that the list of references occupies no less than 266 closely printed octavo pages. The plan is a slight modification in style of that first followed in the 'Index to the Literature of Uranium,' printed in 1870 by the present writer. Professor Howe has taken great pains to make the work complete at every point; he gives the titles of the one hundred periodicals examined, indicating by asterisks the complete sets, and at the end of the book a classified subject-index and an alphabetical author-index fill over fifty pages. In a series of references to articles dealing with a given topic the reference to the original paper is placed first. So thoroughly has the author ransacked chemical literature that he has probably overlooked very few references to the metals named. Chloroplatinates of organic bases are considered only in the case of those early formed.

To facilitate the use of the indexes the number of each title includes the year; the abbreviations used are chiefly those recommended in 1887 by the Committee on Indexing Chemical Literature of the American Association for the Advancement of Science; and the spelling of chemical terms conforms to the rules adopted in 1892 by the same Association.

For the publication of this valuable bibliography the chemical world is indebted to the Smithsonian Institution; it forms No. 1,084 of the Smithsonian Miscellaneous Collections.

Inspection of the volume enables one to form some idea of the relative activity in chemistry at different periods; in 1792 there were three papers published on the subjects included; in 1840 there were 14 papers; in 1860, 22 papers, and in 1892 there were no less than 68 papers. These numbers do not include abstracts and reproductions of original publications.

It is also interesting to note the relative frequency of the occurrence of the names of certain chemists; thus J. W. Döbereiner published 43 papers between the years 1814 and 1845; his great contemporary Berzelius, 25 papers between 1812 and 1847; H. St. Clair Deville, a generation later, published 31 papers (1852–1882), and S. M. Jörgensen has published 27 papers between 1867 and 1896, his activity being still productive. Of course, the number of the papers does not indicate the relative importance of the discoveries; W. H. Wollaston, for example, published only nine papers, but his influence on the chemistry of platinum has been notable.

The volume is clearly printed and seems to be quite free from typographical errors; Edmonde Fremy's name, however, appears as Frémy throughout the work, but Fremy never used the accent on the first vowel in his name.

Howe's 'Bibliography of Platinum' will be a necessity to every working chemist and to every scientific library.

H. CARRINGTON BOLTON.

The Development of the Frog's Egg. An Introduction to Experimental Embryology. By THOMAS HUNT MORGAN, PH.D., Professor of Biology, Bryn Mawr College. New York and London, The Macmillan Company. Pp. xi + 192. Price, $1.60.

As the first attempt to present a connected account of the development of any animal from the standpoint of the new experimental school of morphologists, Professor Morgan's book on the development of the frog will be received with much interest. The time is ripe for a summary of the experimental work on the early stages of development, showing what has and what has not been accomplished by this much discussed method of investigation. Professor Morgan gives us an account of the embryology of the frog, laying especial weight 'on the results of experimental work, in the belief that the evidence from this source is the most instructive for an interpretation of the development.' We shall hope, therefore, in its perusal to learn how much has been accomplished in making clear the course of events in the embryology of a single animal by means of experiment. The egg of the frog has become the classical object for this sort of research, so that a more favorable choice of subject for this purpose could not be made.

The scope of the work is not confined, however, to results achieved by experiment. The book undertakes to give a 'continuous account of the development, as far as that is possible, from the time when the egg is forming to the moment when the young tadpole issues from the jelly membranes,' drawing upon both descriptive accounts of the normal development and experimental work to make it complete. The sub-title, however, makes us justly expect that the experimental results will form the chief aim of the book.

After a half-page introduction on the egg laying and copulation of the frog, Professor Morgan opens his account in Chapter I. with a discussion of the formation of the sex-cells, followed in Chapter II. by a description of the processes of egg laying, formation of the polar bodies and fertilization. With Chapter III. we enter upon the first account of experimental work, a short *résumé* of the researches of Pflüger, Born and others upon cross-fertilization in the Amphibia.

Chapter IV. treats of the normal cleavage of the frog's egg, with the variations met with under natural conditions. The question is proposed: What determines the plane of cleavage in the unsegmented egg? Roux's contention that this is determined by the plane of apposition of the two pronuclei is stated, but the actual determining factor is held to be still in doubt, with the evidence rather against Roux's view. Further discussion of this question is reserved for a later chapter. As to the factors determining the form and arrangement of the cleaving cells, the author discusses here only the surface tension theory, again reserving, according to a plan which can hardly be said to conduce to unity other supposed factors

to a much later chapter. The discussion at this point takes the form of an illustrated account of Roux's experiments on the form and arrangement of oil-drops divided into parts similar to the blastomeres of the egg. The conclusion is drawn that surface tension is an important factor in the arrangement of cleaving cells, but that these are influenced also by many other factors which prevent them from showing always the typical arrangement demanded by surface tension alone.

Chapters V. and VI. are devoted to a descriptive account of the developmental processes from cleavage until after the establishment of the germ layers. The formation of the embryo by concrescence makes the basis of an exceptionally clear and satisfactory description of the complicated processes taking place. In this connection is given a brief statement of the experimental evidence (formation of extra-ovates, etc.) of the changes taking place, and of the correspondence of particular parts of the egg with parts of the later embryo, and the attempts of His to explain many of the processes of development by means of experiments with elastic plates are outlined.

The nucleus of the book is formed by Chapters VII. to XII., which are devoted to the experiments for which the frog's egg has served as the most frequent object in the study of early developmental processes. This account of experimental work is not brought into any close connection with the foregoing description of the normal development of the frog. The latter is closed off, up till after the formation of the germ layers, then the experimental work on early stages is taken up. The account of this is classified only loosely according to the processes and problems studied, the arrangement adopted being chiefly a historical one.

Chapter VII. gives an account of the experimental production of embryos with spina bifida, with especial reference to its bearing on the formation of the embryo by concrescence of the two halves of the germ ring.

Chapters VIII. to XI. are devoted to an account, arranged chiefly historically, of the experiments of Pflüger, Born, Roux and many later investigators on the modifications in development induced by an altered relation of the egg to the direction of gravity, by compression and by killing or isolating individual blastomeres in early stages. This forms one of the most instructive chapters in the history of biological investigation and theory, illustrating and emphasizing, as it does, the necessity for extreme caution in generalizing the results of experiments and observations on single forms, and showing how false may be the conclusions based upon the clearest evidence when that evidence is not gathered from extensive comparative researches. The lesson thus gained has been of the greatest importance and has doubtless been one of the most valuable results of this series of investigations. It would be interesting to review here, following Professor Morgan, the problems proposed, the experiments undertaken to answer these questions, the conclusions drawn from these experiments, and the continued modification of these conclusions as the circle of experimentation became wider.

The history of the development of opinion as to the conclusions to be drawn from the 'total' or 'partial' development of isolated blastomeres, of the theories concerning the part played by gravity in cleavage, and of the general factors determining the direction and position of cleavage planes, is remarkably instructive. Almost more important, as leading to more definite positive conclusions, is the history of the gradual change from the view that the nucleus is the all-important factor in formative processes, to that which seeks the essential factors in the cytoplasm, culminating with Driesch and Morgan's demonstration that in the ctenophore purely cytoplasmic injuries to the egg result in corresponding modifications in the larva. But for a full discussion of these and other matters the reader must be recommended to a perusal of the book itself.

A few words may be added as to Professor Morgan's own conclusions in regard to some of the problems discussed. Although he states in the preface that he has avoided the discussion of theoretical questions, as out of place in such a book, he does give his views on a number of important points.

In Chapter XII., 'Interpretations and Conclusions,' a clear and appreciative survey is given of Roux's profound analysis of the problems of

development in his earlier papers, and of the grounds for his later conclusions in favor of the qualitative nature of cleavage and the 'self-differentiation' of the blastomeres. This review is most satisfactory in its spirit of fairness and in its appreciation of the magnificent work of Roux, and stands in refreshing contrast in these respects to much recent scientific (?) discussion of this investigator's views on the other side of the Atlantic. The author then proceeds to develop the difficulties in Roux's theory and presents grounds for a different view. He points out that in all cases, except the ctenophore egg (and the unmentioned gasteropod egg), it has been shown that the early blastomeres have each the power to produce the whole embryo, though under certain circumstances they may not do so. The author believes that there is no profound difference in principle between the conditions in the ctenophore (and gasteropod?) egg and elsewhere; the divergent results in this case, he thinks, may be explained by the fixity of the protoplasmic forms in the ctenophore egg, or some kindred condition. This totipotence of the embryonic cells may persist, Professor Morgan believes, to late stages. The chief reason why cells of later cleavage stages cannot produce entire embryos is because their power of cell division is limited; hence enough cells cannot be produced to form a complete embryo. (The very important work of Crampton, showing that the development of the isolated blastomeres of the gasteropod is, like that of the ctenophore, throughout partial in character, is unaccountably left unmentioned by the author, though he cites other articles which appeared in later numbers of the same journal in which Crampton's paper was published.)

What, then, brings about the later differentiation of cells if all the blastomere are totipotent? The author rejects the theory of qualitative division of the nucleus; he holds it impossible also that the interaction of equivalent blastomeres should induce differentiation. That the distribution of yolk, etc., does not determine differentiation is shown by the production of normal larvæ from that half of the echinoderm eggs which contain no yolk. Professor Morgan can only emphasize again that the experiments on the ctenophore egg indicate that the factors in differentiation, whatever they may be, are situated in the cytoplasm. What these factors are, or even whether they may be placed in the category of physico-chemical causes, we do not know.

The remainder of the book, except the last chapter, is taken up with a descriptive account of the development of the frog's egg, from the establishment of the germ layers to the moment when the young tadpole emerges from the jelly membranes. This account is chiefly abridged from Marshall, and the figures are mostly copies from the same author. Experimental work on the later stages is not introduced, the remarkably interesting experiments of Born on the grafting of parts of young tadpoles being too recent to be included in the present volume.

The last chapter is a brief review of researches on the effects of different temperatures and different lights on development. An appendix gives some hints on reagents, methods of preservation, etc., and the whole is closed by an extended bibliography.

Those chapters of the book (VII.–XII.) which deal with the experimental work on the early stages of development will be found a most satisfactory presentation of the results in this interesting line of work. The *résumé* is extended enough to bring out all essential points, is clearly written, fair and appreciative in its account of opposing views, and the conclusions set forth by the author are cautious and undogmatic.

The partially historical arrangement of the material is advantageous in many respects. It brings out with especial clearness the necessity of caution in interpreting experiments on simple organisms, shows the fluctuations of opinion in regard to the problems involved, and aids essentially in understanding the present status of investigation and opinion in regard to these matters. On the other hand, this arrangement brings the discussion of the experimental work out of relation with the rest of the book. We should expect, from the title of the work and the preface, that the descriptive account of the embryology of the frog would give the order of development of the subject. Certain processes which require explanation coming up in this account, it might be antici-

pated that the experiments bearing upon these points would be detailed and the conclusions to be drawn from them pointed out. In this way it would have become much clearer how much or how little experimental work had done in elucidating the development of the frog, and the book would have been given a unity which it does not now possess. The descriptive portions and the account of experimental work might have been bound under separate covers, neither volume showing a decided lack of the matter treated in the other. It may be questioned if a volume on the general subject of 'Experimental Embryology,' from so competent a hand as that of Professor Morgan, with no attempt even nominally to limit the discussion to a particular egg, would not have met the demand more precisely than the present work. The descriptive chapters will hardly take the place of Marshall's work on the embryology of the frog, and this portion of the book seems in some respects not so well presented as that on the experimental results. In some chapters the arrangement is a confused one. Thus, after an extended discussion of the cleavage of the egg and especially the variations in that process, and after the egg has been brought to the blastula stage, we find again (p. 41) a paragraph adding some new facts as to the first and second cleavages. At times one misses a clear-cut statement of the question upon which a set of observations or experiments bear. For example, in the account of Roux's experiments with oil-drops, pp. 43–47, it is mentioned only incidentally that the question here is as to the part played by surface tension in cleavage, so that the point might easily be missed by one not acquainted with previous discussions on the subject. In the descriptive chapters typographical and other errors also are more frequent; a particularly confusing matter is the incorrect reference in the text to the lettering of the figures, in a number of cases. Thus occurs on p. 41 ('Fig. 12 G. H.'), p. 105 ('A^1–B^2' and 'Fig. 33 B'), p. 156 ('Fig. 47 B'). In several cases the discussion would be made much clearer if the successive cleavage planes could have been numbered in the figures.

The descriptive part, however, whatever be its merits or demerits, is not the distinctive feature of Professor Morgan's book; it is for the account of experimental work that it will be read; and for this it will be found of the greatest value.

HERBERT S. JENNINGS.
MONTANA COLLEGE OF AGRICULTURE AND MECHANIC ARTS, BOZEMAN, MONTANA.

Geologic Atlas of the United States, Folio 36. Pueblo, Colorado, 1897.

The folio consists of seven pages of text, signed by Grove Karl Gilbert; a topographic map; maps showing the areal geology, economic geology, structure sections, deformation and data pertaining to artesian water; a sheet of columnar sections, and a sheet showing typical fossils and special types of outcrop. The scale is 1: 125,000, and the area described is comprised between parallels 38° and 38° 30′ and meridians 104° 30′ and 105°.

The quadrangle includes a portion of the Great Plains close to the base of the Rocky Mountains. The topography is partly of the foothill type and is in general sufficiently rugged to exhibit clearly the stratigraphy and structure. In the western part are portions of the great hogback formed by the upturned edge of the Dakota sandstone.

The formations range from Archean to Pleistocene. The Paleozoic rocks have a thickness of but two or three hundred feet and their exposures are unimportant. The Juratrias rocks, comprising bright-colored shales and sandstones, have an extreme thickness of 2,500 feet, but their surface extent is small. The Cretaceous rocks range from the Dakota formation to the Pierre and cover nine-tenths of the area. They consist chiefly of gray shale; in a total thickness of 3,800 feet there are only 75 feet of limestone and 300 to 500 feet of sandstone, the latter being at the base of the series. One hundred feet of alluvial sand and gravel are referred to the Neocene, and other alluvial deposits to the Pleistocene.

Unconformities appear at the base of the Paleozoic, Cretaceous, Neocene and Pleistocene formations, and the geologic history is correspondingly complex. The structure of the Paleozoic and Juratrias rocks was ascertained only in the limited area of their exposure. The

structure of the Cretaceous rocks was determined more completely, and, as it has important economic bearings in connection with artesian water, a special sheet is devoted to its presentation. In a plaster model the upper surface of the Dakota sandstone was restored so as to exhibit its flexures and faults, and a lithographic plate was prepared from a photograph of this model. The general trend of the flexures is NNW, and the faults have the same course.

The flext rocks have been subjected to erosion during a large part of Tertiary time, with the result that the relief expresses the principal facts of structure with great fidelity. Inclined outcrops of the resistant Dakota sandstone form monoclinal ridges from 600 to 1,200 feet in height. A limestone at the base of the Niobrara formation is exprest in a system of sloping plains, mesas and ridges, which the details of structure render somewhat complex. The outcrop of another limestone is markt through a wide range of territory by a characteristic terrace, and other terraces are determined by Neocene and Pleistocene alluvial formations.

Among the economic materials are sandstones available for structural purposes, limestones available for lime, and flux, gypsum and fireclay. Artesian water, contained in the Dakota sandstone, underlies nine-tenths of the quadrangle, and the structural relations indicate that in about one-sixth of the quadrangle the head is sufficient to carry it to the surface. A special map indicates its distribution, showing separately the flowing and pumping areas and indicating by contours the estimated depth of the water below the surface of the ground.

The text is adjusted to the needs of lay readers; technical language is avoided, so far as may be, and where avoidance is impracticable the terms used are explained.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 286TH MEETING, SATURDAY, JANUARY 29.

MR. WILLIAM PALMER read a paper on the Birds of the Pribilof Islands, Alaska, stating that 69 species were known from that locality. Of these, 18, mostly stragglers, are American, 28 are exclusively Pacific, 17 are circumpolar and but 6 Asiatic. None of the Asiatic species breed on the islands, and but one of the American species. Seventeen of the Pacific forms and four of the circumpolar, however, breed on the Pribilofs. With the exception of eleven land birds, four of which are common and breed, the entire avifauna is composed of water birds and waders. Thousands of birds pass southwards through the Aleutian Islands during the autumnal migration to their winter homes on the coast of Asia. Others journey direct to the Hawaiian and other islands of the Middle and South Pacific, thus making the longest transoceanic journeys known to be made by birds.

Dr. L. O. Howard presented, under the title 'The European hornet in America,' some brief notes about *Vespa crabro*. He exhibited specimens of the larva and pupa of this insect taken by Dr. E. G. Love from a nest found near Jamaica, Long Island. He also showed photographs of the nest, both in longitudinal and horizontal section. He showed that this insect has been present in this country in the vicinity of New York City certainly since 1848, but that during that time it has spread less than 150 miles from its point of introduction, the most distant point at which it has certainly been found being Anglesea, N. J. Reported occurrences in Maryland and North Carolina were considered doubtful by the speaker. He further called attention to the fact that, while in Europe the species usually inhabits outhouses, in this country its nests have almost invariably been found in hollow trees.

F. A. LUCAS,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of January 17, 1898, seventeen persons present, a paper by Charles Robertson, entitled 'New or Little Known North American Bees,' was read in abstract and referred to the Council for publication. Dr. A. C. Bernays addressed the Academy on biological facts as evidence of man's place in nature. He illustrated certain facts from the ontogeny of man by description and blackboard sketches, and tried to explain the anatomical peculiarities in the structure of

man and the lower animals by the biogenetic law of Haeckel. He also made some suggestions about the best method of studying and of teaching anatomy. It was claimed that in the biogenetic law of Haeckel a scientific background, or rather a working hypothesis, was given, by means of which the recorded facts of zoology, botany, paleontology, etc., were made understandable and really became useful to science. He also gave a definition and illustration of the meaning of the term differentiation as used in biology.

Three new members were elected.

At the meeting of February 7, 1898, fourteen persons present, a paper by Professor A. S. Hitchcock, on the ecological plant geography of Kansas, was presented and referred to the Council for publication. Professor L. H. Pammel spoke on the anatomical characters of seeds from the standpoint of systematic botany, presenting in abstract the results of an extensive study of the subject, on which he has been engaged for some years past.

Twenty-four new members were elected.

WILLIAM TRELEASE,
Recording Secretary.

AMERICAN CHEMICAL SOCIETY.

THE regular meeting of the New York Section of the American Chemical Society was held on Friday evening, February 4th. Dr. Wm. McMurtrie presided, and seventy-two members and vistors were present.

The chairman opened the meeting with a very interesting surprise in the announcement that he had just received a half-gallon of liquid air from Mr. Tripler, and the first half-hour was occupied in an exhibition of its properties.

The liquid was ladled out of a covered receptacle packed in several thicknesses of felt, very much as if it had been ordinary ice water, but on pouring it into any glass, porcelain or iron vessel it boiled with great violence until the container cooled to the temperature of the intensely cold liquid, which means about —310° F.

Drops falling on the lecture table immediately took the spheroidal form and ran about exactly as drops of water on a hot stove. Placed in a glass beaker the liquid first boiled, then became clouded with a crystalline precipitate of carbon dioxide, which was present as an impurity, and from which it was separated by filtration through an ordinary paper filter, and the clear liquid was caught in a double-walled glass cylinder. The space between the walls, having been exhausted, to produce a vacuum, the clear, slightly blue liquid air remained in the tube for over an hour before complete evaporation. Among other experiments, alcohol was quickly frozen, rubber tubing was hardened by the low temperature so as to break when struck by a hammer almost like glass, and a piece of thin sheet iron, after immersion in the cold liquid, became very brittle.

The following papers were read: 'Determination of Boric Acid,' T. S. Gladding; 'Recent Progress in the Chemistry of the Leather Industry,' J. H. Yocum; 'Review of Chemical and Physical Methods for Examining Documents and Handwriting,' C. A. Doremus.

The next meeting will be held on March 11th.

DURAND WOODMAN,
Secretary.

NEW BOOKS.

Text-Book of Zoology. T. JEFFERY PARKER and WILLIAM A. HASWELL. London and New York, The Macmillan Company. 1897. Vol. I., pp. xxxv + 779. Vol. II., pp. xx + 683. $9.00.

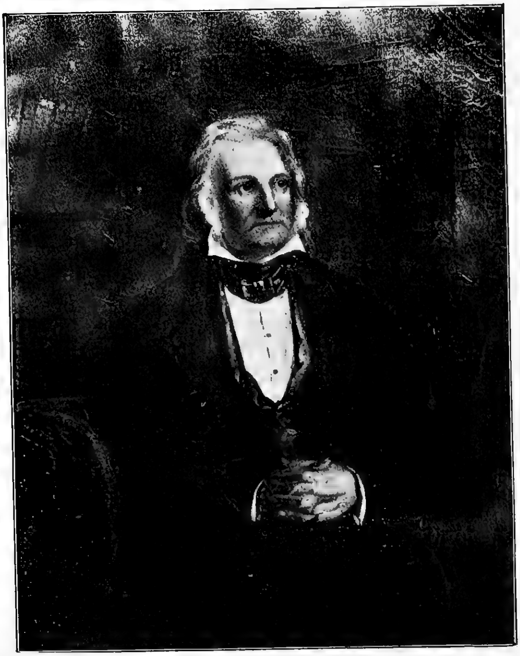
Lehrbuch der Entwicklungsgeschichte des Menschen. J. KOLLMANN. Jena, Gustav Fischer. 1896. Pp. xii + 658. 15 Marks.

Organographie der Pflanzen. K. GOEBEL. 1st Part, *Allgemeine Organographie.* Jena, Gustav Fischer. 1898. Pp. ix + 232. 6 Marks.

Laboratory Experiments on the Class Reactions and Identification of Organic Substances. ARTHUR A. NOYES and SAMUEL P. MULLIKEN. Easton, Pa., Chemical Publishing Co. 1897. Pp. 28. 50 cts.

The Freezing Point, Boiling Point and Conductivity Methods. HARRY C. JONES. Easton, Pa., Chemical Publishing Co. 1897. Pp. vii + 64. 75 cts.

Garden Making. L. H. BAILEY. New York and London, The Macmillan Company. 1898. Pp. vii + 417. $1.00.



John James Audubon.

SCIENCE

FRIDAY, MARCH 4, 1898.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

AUDUBON AND HIS JOURNALS.

THE memory of Audubon is dear to the hearts of the American people. The vigor and versatility of his writings, the eminence he attained as a naturalist, and his high personal character won him the admiration of his contemporaries and made him an honored son in the land of his adoption. Born at an opportune time and transported to the New World when still a lad, he undertook and accomplished one of the most gigantic tasks it has ever fallen to the lot of one man to perform. Although for years deflected from the course Nature had laid out for him, and tortured by half-hearted attempts at a commercial life against which his restive spirit rebelled, he finally broke loose from his bondage and devoted the remainder of his days to the grand work which has made his name immortal.

Audubon was a man of phenomenal powers of endurance and indomitable courage; his determination, perseverance and force of character are shown by the way he overcame seemingly insuperable obstacles. Is it not extraordinary that a person of his humble means should not only complete such an unparalleled series of paintings but should cross the ocean, make friends and admirers of noblemen and leading men of science, and succeed, in spite of the enormous cost, in bringing out in colors an atlas of 435 double elephant folio plates of birds?

His magnificent contributions to the natural history of the New World have not been surpassed. The best known of these is the *Birds of America.** The equally

*The plates were originally issued in 87 parts, covering a period of twelve years (1827–1838). The

sumptuous *Quadrupeds of North America*, the text of which was published under joint authorship with Dr. John Bachman of Charleston (1846–1854), was apparently not begun until the bird books had been completed.

Audubon's fame as a painter of birds is world wide and his *Birds of America* is described by an eminent ornithologist as 'by far the most sumptuous ornithological work ever published.' His genius and power as a painter of mammals was even greater though less widely known, owing to the rarity of his magnificent folio plates of 'Quadrupeds.' He must have been nearly seventy when he began these drawings and it is no wonder he was not able to finish all of them himself. Happily, his sons Victor and John Woodhouse inherited his talent and were able to complete the series, thus perfecting a work the equal of which no other man or country has yet produced.

One is surprised at the misgivings with which Audubon undertook the preparation of the *Ornithological Biography*, as shown by an entry in his journal for October 16, 1830, where he writes depreciatingly: "I know that I am a poor writer, that I scarcely can manage to scribble a tolerable English letter, and not a much better one in French, though that is easier to me. I know I am not a scholar, but meantime I am aware that no living man knows better than I do the habits of our birds; no man living has studied them as much as I have done, and with the assistance of my old journals and memorandum-books which were written on the spot, I can at least put down plain truths, which may be useful and perhaps interesting, so I shall set to at once. I cannot, however, give *scientific* descriptions, and here must have assistance." This technical assistance was rendered by the well-known ornithologist, William MacGillivray. And many years later, when Audubon joined forces with John Bachman in the preparation of their great work on Mammals, the latter author looked after the technicalities. It must not be inferred from this that Audubon lacked a scientific knowledge of the distinctive characters of species; on the contrary he had a keen appreciation of these matters as every one knows who is familiar with his writings, but the drudgery of preparing technical diagnoses was so distasteful to him, and he was kept so busy with his paintings and biographies, that he preferred to let others do this part of the work.

text, entitled *Ornithological Biography*, was not begun until 1830, and the original five volumes appeared at intervals from 1831 to 1839.

The absence of a trustworthy biography of Aububon has been a matter of such general regret that the recent appearance of two handsome volumes entitled *Audubon and his Journals** is hailed with widespread satisfaction. The author, Miss Maria R. Audubon, a daughter of John Woodhouse Audubon and granddaughter of the celebrated naturalist, had the rare advantage of familiarity with the family traditions and the possession of unpublished manuscripts. She has supplied not only a reliable and entertaining account of Audubon's life, but also the full text of his most important journals—those of his trips to Europe, Labrador, and the Missouri and Yellowstone Rivers. Many of his journals and manuscripts were early destroyed by fire, and others lost, but happily those of greatest value have been discovered and are now for the first time made public. From these we learn so much of interest that only the merest outline can be given here.

**Audubon and His Journals*. By Maria R. Audubon, with Zoological and other Notes by Elliott Coues. New York, Charles Scribner's Sons. December, 1897. Large 8vo. Vol. I., pp. xiv+532, pls. 22; Vol. II., pp. viii+654, pls. 15. $7.50.

Since the object of the present article is to call attention to the fund of information contained in the journals nothing need be said of Audubon's personal history or the vicissitudes of his early and middle life.

In his search for mammals and birds Audubon traveled thousands of miles afoot in the Eastern and Southern States, from Maine to Florida, Louisiana and Texas, and made special expeditions to Labrador and the Yellowstone—the latter at a time of life when most men who have lived to reach such a ripe age seek the quiet and comforts of home. It was on this latter trip he wrote: "I am getting an old man, for this evening I missed my footing on getting into the boat and bruised my knee and elbow, but at seventy and over I cannot have the spring of seventeen."

In 1833, when about sixty years of age, Audubon chartered a schooner and with his son John Woodhouse, and four other companions, set sail for Labrador to obtain additional material for his great work on the *Birds of America.* The journal of this cruise overflows with interesting observations in natural history and is of special value to the ornithologist. Now and then an error of interpretation creeps in, as when 'tracks of Deer and Caribou' are mentioned—for the only deer in Labrador is the Caribou—and when glacier-carried boulders are supposed to have been cast up by the sea.

On their way the party visited Bird Rock in the Gulf of St. Lawrence. It was on the 14th of June, and "at eleven," Audubon writes, "I could distinguish its top plainly from the deck, and thought it covered with snow to a depth of several feet; this appearance existed on every portion of the flat, projecting shelves. Godwin [the pilot] said, with the coolness of a man who had visited this rock for ten successive seasons, that what we saw was not snow—but Gannets! I rubbed my eyes, took my spy-glass, and in an instant the strangest picture stood before me. They were birds we saw,—a mass of birds of such a size as I never before cast my eyes on. The whole of my party stood astounded and amazed, and all came to the conclusion that such a sight was of itself sufficient to invite any one to come across the Gulf to view it at this season. The nearer we approached, the greater our surprise at the enormous number of these birds, all calmly seated on their eggs or newly hatched brood, their heads all turned to windward."

On the 17th of June the party reached South Labrador, in the neighborhood of Natasquan, and Audubon wrote in his journal: "The shores appeared to be margined with a broad and handsome sand-beach; our imaginations now saw Bears, Wolves, and Devils of all sorts scampering away on the rugged shore." A little later he continues:

"And now we are positively on the Labrador coast, Latitude 50° and a little more,—farther north than I ever was before. But what a country! When we landed and passed the beach, we sank nearly up to our knees in mosses of various sorts, producing as we moved through them a curious sensation. These mosses, which at a distance look like hard rocks, are, under foot, like a velvet cushion. We scrambled about, and with anxiety stretched our necks and looked over the country far and near, but not a square foot of *earth* could we see. A poor, rugged, miserable country; the trees like so many mops of wiry composition, and where the soil is not rocky it is boggy up to a man's waist."

A few days later he gave a more pleasing picture:

"The country, so wild and grand, is of itself enough to interest any one in its wonderful dreariness. Its mossy, gray-clothed rocks, heaped and thrown together as if by chance, in the most fantastical groups im-

aginable, huge masses hanging on minor ones as if about to roll themselves down from their doubtful-looking situations, into the depths of the sea beneath. Bays without end, sprinkled with rocky islands of all shapes and sizes, where in every fissure a Guillemot, a Cormorant, or some other wild bird retreat to secure its eggs and raise its young, or save itself from the hunter's pursuit. The peculiar cast of the sky, which never seems to be certain, butterflies flitting over snow-banks, probing beautiful dwarf flowerets of many hues pushing their tender stems from the thick bed of moss which everywhere covers the granite rocks. Then the morasses, wherein you plunge up to your knees, or the walking over the stubborn, dwarfish shrubbery, making one think that as he goes he treads down the *forests* of Labrador."

Those who have felt the fury and grandeur of a Labrador storm will appreciate Audubon's description of one he witnessed July 10, 1833, when the blasts 'seemed strong enough to rend the very rocks asunder.' He says:

"The rain is driven in sheets which seem scarcely to fall on sea or land; I can hardly call it rain, it is rather a mass of water, so thick that all objects at any distance from us are lost to sight every three or four minutes, and the waters comb up and beat about us in our rock-bound harbor as a newly caged bird does against its imprisoning walls. The great Black-backed Gull alone is seen floating through the storm, screaming loudly and mournfully as it seeks its prey; not another bird is to be seen abroad; the Cormorants are all settled in the rocks close to us, the Guillemots are deep in the fissures, every Eider Duck lays under the lee of some point, her brood snugly beneath her opened wings, the Loon and Diver have crawled among the rankest weeds * * * and the gale continues as if it would never stop."

Ten years after the Labrador trip Audubon made his famous expedition to the junction of the Missouri and Yellowstone Rivers. The journals of this expedition, which was undertaken solely for the sake of his work on the Quadrupeds of North America, are storehouses of information. He set out from New York for St. Louis, March 11, 1843, and took with him Edward Harris, John G. Bell, Isaac Sprague and Lewis Squires. The party left St. Louis by river steamboat on the 25th of April, but owing to contrary winds, innumerable sand-bars, and the delays incident to cutting fire-wood for the engine along the way, it was the 12th of June before they reached Fort Union.

In those days Parakeets were common along the Missouri, and were seen, the journal states, near St. Joseph, Missouri; at Fort Leavenworth, Kansas; near the mouth of the Platte River, Nebraska; near Council Bluffs, Iowa, and at several points near Great Bend, South Dakota. Big game abounded everywhere. An important record is that of the Black-tail or Mule Deer at the mouth of Little Sioux River, Harrison County, Iowa, where four were seen May 12, 1843. This species was long before exterminated in this region and is not included in Allen's list of the mammals of Iowa, published in 1869. Two weeks later one was shot and others seen at Great Bend, South Dakota.

Elk or Wapiti were noted at various places in Nebraska and Dakota from opposite the mouth of the Little Sioux River northward; Antelope were said to occur within 25 miles of Fort Vermilion, South Dakota, and the first Buffaloes were observed near the mouth of the James River in the same State. A little higher up the latter animals were seen constantly and often in enormous numbers.

Before reaching Fort Pierre the party met a curious boat which "instead of being

made of wood, had only a frame, covered with Buffalo skins with the hair on." The two occupants "had been nine days coming 150 miles, detained every day, more or less, by Indians."

In the entry for May 25th, Audubon mentions meeting three Mackinaw barges a little below the mouth of White River, South Dakota. "On the roofs of the barges" he writes "lay much Buffalo meat, and on the island we left this morning probably some hundreds of these poor animals, mostly young calves, were found dead at every few steps; and since then we have passed many dead as well as many groups of living. In one place we saw a large gang swimming across the river; they fortunately reached a bank through which they cut their way towards the hills." Later the same day he says: "Within the last mile or so we must have passed upwards of a hundred drowned young Buffalo calves, and many large ones." On the 28th, between Great Bend and Fort George "both shores were dotted by groups of Buffaloes as far as the eye could reach," and by noon he estimated that he had seen more than 2000.

On the 6th of June Audubon stopped to see the famous Mandan village, on the west side of the Missouri nearly opposite the spot now occupied by Bismarck, the capital of North Dakota. The inhabitants at the time were mainly Riccarees, the Mandans having been almost exterminated by small pox 5 or 6 years before. In his journal Audubon thus describes the appearance of the village and its inmates: "The Mandan mud huts are very far from looking poetical, although Mr. Catlin has tried to render them so by placing them in regular rows, and all of the same size and form, which is by no means the case. But different travellers have different eyes! We saw more Indians than at any previous time since leaving St. Louis, and it is possible that there are a hundred huts, made of mud, all looking like so many potato winter-houses in the Eastern States. * * The appearance of these poor, miserable devils, as we approached the shore, was wretched enough. There they stood in the pelting rain and keen wind, covered with Buffalo robes, red blankets, and the like, some partially and most curiously besmeared with mud; and as they came on board, and we shook hands with each of them, I felt a clamminess that rendered the ceremony most repulsive."

The Bighorn or Mountain Sheep, which still occurs sparingly in the 'badlands' of North Dakota, was then abundant and not infrequently appeared along the Missouri near the mouth of the Yellowstone, where a band of 22 was observed by Audubon and his associates.

At length, on the 12th of June, 48 days after setting out from St. Louis, the party arrived at the end of their journey and were heartily welcomed and hospitably entertained by Mr. Culbertson, the fur trader in charge of Fort Union.

Speaking of his quarters at the fort Audubon says: "Our room was small, dark, and dirty, and crammed with our effects. Mr. Culbertson saw this, and told me that to-morrow he would remove us to a larger, quieter, and better one. I was glad to hear this, as it would have been very difficult to draw, write, or work in; and yet it is the very room where the Prince de Neuwied [Maximilian, Prince of Wied] resided for two months, with his secretary and bird-preserver. The evening was cloudy and cold; we had several showers of rain since our bath in the bushes this morning, and I felt somewhat fatigued. Harris and I made our beds up; Squires fixed some Buffalo robes, of which nine had been given us, on a long old bedstead, never knowing it had been the couch of a foreign prince; Bell and Sprague settled themselves opposite to us on more Buffalo skins, and night closed in."

The journal of the stay at Fort Union is a running account of the daily life at this remote outpost, with records of hunting—particularly Buffalo and Wolf hunting—and observations on the habits of birds, mammals, Indians, half-breeds, and traders, interspersed with graphic episodes and descriptions of the country. Audubon speaks also of his labors in painting new birds and quadrupeds—the real object of his trip—and tells of the successes and disappointments attending his ceaseless efforts to obtain new or rare specimens.

Wolves were very abundant about the fort and were often shot from the ramparts. A week after Audubon's arrival his journal contains this record: "*June 19, Monday.* It began raining early this morning; by 'early,' I mean fully two hours before daylight. The first news I heard was from Mr. Chardon, who told me he had left a Wolf feeding out of the pig's trough, which is immediately under the side of the fort. The next was from Mr. Larpenteur, who opens the gates when the bell rings at sunrise, who told us he saw seven Wolves within thirty yards, or less, of the fort. I have told him since, with Mr. Chardon's permission, to call upon us before he opens these mighty portals, whenever he espies Wolves from the gallery above, and I hope that to-morrow morning we may shoot one or more of these bold marauders. Sprague has been drawing all day, and I a good part of it; and it has been so chilly and cold that we have had fires in several parts of the fort. Bell and Harris have gone shooting this afternoon, and have not yet returned. Bell cleaned the Wolf shot last night, and the two Antelopes; Old Provost broiled brine, and the whole of them are now in pickle. * * * * —*Later.* Harris and Bell have returned, and, to my delight and utter astonishment, have brought two new birds: one a Lark, small and beautiful [named by Audubon, Sprague's Lark and now known to naturalists as *Anthus spraguei*]; the other like our common Golden-winged Woodpecker, but with a red mark instead of a black one along the lower mandible running backward." A few days later he adds some valuable notes on the habits of the Lark: "The little new Lark that I have named after Sprague has almost all the habits of the Skylark of Europe. Whilst looking anxiously after it, on the ground where we supposed it to be singing, we discovered it was high over our heads, and that sometimes it went too high for us to see it at all. * * * * * * The male rises by constant undulations to a great height, say one hundred yards or more; and whilst singing its sweet-sounding notes, beats its wings, poised in the air like a Hawk, without rising at this time; after which, and after each burst of singing, it sails in divers directions, forming three-quarters of a circle or thereabouts, then rises again, and again sings; the intervals between the singing are longer than those which the song occupies, and at times the bird remains so long in the air as to render it quite fatiguing to follow it with the eye. Sprague thought one he watched yesterday remained in the air about one hour. Bell and Harris watched one for more than half an hour, and this afternoon I gazed upon one, whilst Bell timed it, for thirty-six minutes."

The journal of the return trip from Fort Union contains many interesting records, the general character of which may be gleaned from the following:

August 16. Started from Fort Union at 12 M. in the Mackinaw barge 'Union.' Shot five young Ducks. Camped at the foot of a high bluff. Good supper of Chickens and Ducks.

Thursday, 17th. Started early. Saw three Bighorns, some Antelopes, and many Deer, fully twenty; one Wolf, twenty-two Swans, many Ducks. Stopped a short time on a bar. Mr. Culbertson shot a female Elk, and I killed two bulls. Camped at Buffalo Bluff, where we found Bear tracks.

* * * * * *

Saturday, 19th. Wolves howling, and bulls roaring, just like the long continued roll of a hundred drums. Saw large gangs of Buffaloes walking along the river. * * *

Sunday, 20th. Thousands upon thousands of Buffaloes; the roaring of these animals resembles the grunting of hogs, with a roaring sound from the throat. * * *

Monday, 21st. Buffaloes all over the bars and prairies, and many swimming; the roaring can be heard for miles. The wind stopped us again at eight o'clock; breakfasted near the tracks of Bears surrounded by hundreds of Buffaloes. We left our safe anchorage and good hunting grounds too soon; the wind blew high, and we were obliged to land again on the opposite shore, where the gale has proved very annoying. Bear-tracks led us to search for these animals, but in vain.

Tuesday, 22d. * * * In the afternoon we started again and went below the Little Missouri, returned to the bull and took his horns, etc. Coming back to the boat Sprague saw a Bear; we went towards the spot; the fellow had turned under the high bank and was killed in a few seconds. * * *

Thursday, 24th. A bad night of wind, very cloudy * * * traveled about twenty miles when we were again stopped by the wind. Hunted but found nothing. The fat of our Bear gave us seven bottles of oil. We heard what some thought to be guns, but I believed it to be the falling of the banks. Then the wolves howled so curiously that it was supposed they were Indian dogs. We went to bed all prepared for action in case of an attack; pistols, knives, etc., but I slept very well, though rather cold. * *

Thursday, 31st. Started early; fine and calm. Saw large flocks of Ducks, Geese, and Swans; also four Wolves. Passed Mr. Primeau's winter trading house; reached Cannon Ball River at half-past twelve. No game; water good-tasted, but warm. Dinner on shore. Saw a Rock Wren on the bluffs here. Saw the prairie on fire, and signs of Indians on both sides. * * *

Thursday [*Sept.*] *7th.* About eleven o'clock last night the wind shifted *suddenly* to northwest, and blew so violently that we all left the boat in a hurry. Mrs. Culbertson [Indian wife of the Ft. Union trader], with her child in her arms, made for the willows, and had a shelter for her babe in a few minutes. Our guns and amunition were brought on shore, as we were afraid of our boat sinking. We returned on board after a while; but I could not sleep, the motion making me very sea-sick; I went back to the shore and lay down after mending our fire. It rained hard for about two hours; the sky then became clear, and the wind wholly subsided, so I went again to the boat and slept till eight o'clock. A second gale now arose; the sky grew dark; we removed our boat to a more secure position, but I fear we are here for another day. Bell shot a *Caprimulgus*, so small that I have no doubt it is the one found on the Rocky Mountains by Nuttall, after whom I have named it. [Now known as Nuttall's Poor-will.] * *

Thursday, [*Sept.*] *28th.* A beautiful morning, and we left at eight. The young man who brought me the calf at Fort George has married a squaw, a handsome girl, and she is here with him. Antelopes are found about twenty-five miles from this fort, but not frequently. Landed fifteen miles below on Elk Point. Cut up and salted the cow. Provost and I went hunting, and saw three female Elks, but the order was to shoot only bucks; a large one started below us, jumped into the river, and swam across, carrying his horns flat down and spread on each side of his back; the neck looked to me about the size of a flour-barrel. Harris killed a hen Turkey, and Bell and the others saw plenty but did not shoot, as Elks were the order of the day. I cannot eat beef after being fed on Buffaloes.

In another place he speaks of beef as 'very inferior to Buffalo.'

Notwithstanding the incredible abundance of Buffaloes at this time Audubon foresaw their inevitable doom, as shown by a prophetic sentence in his journal: "But this cannot last; even now there is a perceptible difference in the size of the herds, and before many years the Buffalo, like the Great Auk, will have disappeared."

One is everywhere impressed by the voluminousness and vigor of the journals. Those who have felt the strain and fatigue of arduous field work know what it costs to write up one's notes at night, when as a rule physical weariness renders literary work out of the question. Manuscripts prepared under such conditions should be read between the lines and criticised with a lenient hand. As a rule the briefest entries follow the busiest days, and when Audubon exclaims, as he does in one place, "I could write a book on the experiences of to-day," it is easy to understand why he wrote so little. In fact, the marvel is that

a man of his age, and one so overwhelmed with work, had the strength and determination to write so much, and the mental clearness to write so well.

Miss Audubon has added to the Missouri River journals a number of footnotes quoting descriptions by early explorers—chiefly Lewis and Clark and Prince Maximilian—of places mentioned by Audubon, thus bringing together on the same page accounts of different authors who visited the region at different times.

Dr. Elliott Coues has supplemented these by another set of footnotes, over his initials, giving modern names of places and other information of geographic and historic interest; and biographical and zoological notes relating to persons and animals mentioned in the text. His familiarity with the region described, and with everything relating to its history, as well as with Audubon's books on birds and mammals, has enabled him to contribute materially to the interest and permanent value of the work. He calls attention to the first mention in the journals of three new species of birds — Bell's Vireo, Harris' Finch and Sprague's Lark—obtained on this expedition and named by Audubon after his companions; to the difference in song of the western Meadowlark from that of its eastern relative; and to the absence of any record of the first capture of the then new LeConte's Sparrow, which he learns from the 'Birds of America' was killed May 24, 1843; and so on.

Now and then he makes a slip, as when he states that the Fox Squirrel mentioned (on page 455 of Vol. I) under the name *Sciurus capistratus* is the one 'with white nose and ears, now commonly called *Sciurus niger*' [the latter is confined to the Southern States; the one to which Audubon refers is the Mississippi Valley Fox Squirrel, *S. ludovicianus*]; and when (p. 526) he ascribes to the late Thomas M. Brewer the introduction of the English Sparrow into this country.*

The close scrutiny Dr. Coues gave the text is indicated by the rarity of lost opportunities. The only really important omission noted relates to a mouse obtained at Fort Union on July 14, 1843, of which Audubon wrote in his journal: "Although it resembles *Mus leucopus* greatly, is much larger, and has a short, thick, round tail, somewhat blunted" (Vol. II, p. 89). Dr. Coues overlooked the fact that this particular specimen afterward became the type of *Mus missouriensis* Aud. & Bach., a species previously described by Maximilian under the name *Hypudæus leucogaster*, and later made by Baird the type of the genus *Onychomys*; it now stands as *Onychomys leucogaster* (Max. Wied.).

So much—and yet so little!—has been said of the Labrador and Missouri River Journals that no space remains to speak of the important 'European Journals,' the entertaining 'Episodes' and the admirable series of portraits† and other illustrations in Miss Audubon's excellent book—a work which no student of American birds, mammals, or history can afford to do without.

C. Hart Merriam.

THE IMPORT OF THE TOTEM.‡

In this study of the significance of the Omaha totem the aim will be to set forth, as clearly as possible, first, what these Indians believed concerning their totems, and,

* The English Sparrow was introduced into the United States in 1850 by Nicolas Pike. Nearly 25 years later Dr. Brewer took up his pen in defense of its introduction and from that time until his death was the Sparrow's only friend among American ornithologists.

†One of these, from a painting by Audubon's son, is reproduced as a frontispiece to the present number of Science by the courtesy of the publishers of the work, Messrs. Charles Scribner's Sons.

‡ A paper read before the Section of Anthropology, of the American Association for the Advancement of Science, at the Detroit Meeting, August, 1897.

secondly, what these totems stood for in the tribal structure.

There will be no attempt in this paper to treat the subject of totems in a world sense; the experience of many years of research within a limited area has shown the writer that close, careful studies of the various tribes and races of the two hemispheres are as yet too few to afford sufficient evidence for a final summing up, from which to deduce points held in common or the equally important lines of divergence found in the beliefs and customs involved in the use of totems.

It is proper to call attention at the outset to a few of the perplexities of a research at first hand in a matter as recondite as that under consideration. There is the difficulty of adjusting one's own mental attitude, of preventing one's own mental atmosphere from deflecting and distorting the image of the Indian's thought. The fact that the implications of the totem are so rooted in the Indian's mentality that he is unconscious of any strangeness in them, and is unable to discuss them objectively, constitutes a grave obstacle to be overcome. Explanations of his beliefs, customs and practices have to be sought by indirect rather than by direct methods, have to be eliminated from a tangle of contradictions, and verified by the careful noting of the many little unconscious acts and sayings of the people, which let in a flood of light, revealing the Indian's mode of thought and disclosing its underlying ideas. By these slow processes, with the analysis of his songs, rituals and ceremonies, we can at last come upon his beliefs concerning nature and life, and it is upon these that the totem is based.

There were two classes of totems known among the Omahas: the Personal, belonging to the individual; and the Social, that of societies and gentes.

The Personal Totem.—The question first to arise is: How did the individual obtain his totem? We learn that it was not received from an ancestor, was not the gift of any living person, but was derived through a certain rite by the man himself.

In the Legend of the Sacred Pole of the Omahas, which has been handed down from generations, and which gives a rapid history of the people from the time when 'they opened their eyes and beheld the day' to the completed organization of the tribe, we are told: "The people felt themselves weak and poor. Then the old men gathered together and said, Let us make our children cry to Wa-kon̈'-da. * * * So all the parents took their children, covered their faces with soft clay, and sent them forth to lonely places. * * * The old men said, You shall go forth to cry to Wa-kon̈'-da. * * * When on the hills you shall not ask for any particular thing, * * * whatever is good, that may Wa-kon̈'-da give. * * * Four days and nights upon the hills the youth shall pray, crying, and when he stops shall wipe his tears with the palms of his hands, lift his wet hands to heaven, then lay them on the earth. * * * This was the people's first appeal to Wa-kon̈'-da."

This rite, called by the untranslatable name Non'-zhin-zhon, has been observed up to the present time. When the youth had reached the age of puberty he was instructed by his parents as to what he was to do. Moistened earth was put upon his head and face, a small bow and arrow given him, and he was directed to seek a secluded spot upon the hills, and there to chant the prayer which he had been taught, and to lift his hands wet with his tears to heaven, and then to lay them upon the earth; and he was to fast until at last he fell into a trance or sleep. If, in his trance or dream, he saw or heard anything, that thing was to become the special medium through which he could receive supernatural aid. The ordeal over, the youth returned home

to partake of food and to rest. No one questioned him, and for four days he spoke but little, for if within that time he should reveal his vision it would be the same as lost to him. Afterwards he could confide it to some old man known to have had a similar manifestation, and it then became the duty of the youth to seek until he should find the animal he had seen in his trance, when he must slay it and preserve some part of it (in cases where the vision had been of no concrete form, symbols were taken to represent it); this memento was ever after to be the sign of his vision, his totem, the most sacred thing he could ever possess, for by it his natural powers were to be so reënforced as to give him success as a hunter, victory as a warrior, and even the power to see into the future.

Belief concerning Nature and Life.—The foundation of the Indian's faith in the efficacy of the totem rested upon his belief concerning nature and life. This belief was complex and involved two prominent ideas: first, that all things, animate and inanimate, were permeated by a common life; and, second, that this life could not be broken, but was continuous.

The Common Life.—The idea of a common life was in its turn complex, but its dominating force was conceived to be that which man recognized within himself as will-power. This power which could make or bring to pass he named Wa-k̈o*n*′-da.

The question arises: Did the Omaha regard Wa-k̈o*n*′-da as a supreme being? There is no evidence that he did so regard the power represented by that word, nor is there any intimation that he had ever conceived of a single great ruling spirit.

Anthropomorphism.—The word Wa-k̈o*n*′-da appears to have expressed the Indian's conception of immanent life, manifest in all things. Growing out of this conception was a kind of anthropomorphism; the characteristics of man were projected upon all nature: the rock, in the rituals, was addressed as 'Aged One!' sitting with 'furrowed brow' and 'wrinkled loins;' the tree lived a double life in the Indian's fancy; as did the water, the fire, the winds and the animals. This duality can be recognized in myths, in legends, in rituals, and in the paraphernalia of ceremonies, in which there is a constant confusion of the external aspect and the anthropomorphic conception. All things were distinct from man, but in the subtle bond of a common life, embodying the idea of will, or directive energy, they were akin to him, and could lend him the aid of their special powers, even as he could help or hinder his fellow men.

Will-power.—We trace the Omaha's estimate of his own will-power in the act called Wa-zhi*n*′-dhe-dhe (wa-zhi*n*, directive energy; dhe-dhe, to send), in which, through the singing of certain songs, strength could be sent to the absent warrior in the stress of battle; or thought and will be projected to help a friend win a game or a race; or even so to influence the mind of a man as to affect its receptivity of the supernatural. Aside from the individual practice of this power, there was, so to speak, a collective energy exercised by the Ho*n*′-he-wa-chi society in the act of Wa-zhi*n*′-a-gdhe (wa-zhi*n*, directive energy; a-gdhe, to place upon), where the members so fixed their will upon an obnoxious person as to isolate him from all helpful relations with men and animals and leave him to die. A similar ability to aid or to injure was imputed to the elements and all natural forms. The winds could bring health to man; the stone insure him long life; the elk could endow the pursued with speed, and the hawk make the warrior sure to fall upon his enemy. But it is to be noticed that while man's own will was believed to act directly, without intervening instrumentality upon his fellows, the supplementing of

man's powers by the elements and the animals was obtainable only after an appeal to Wa-k̈on'-da, in the rite of the vision.

The Appeal.—The prayer, which formed a part of the rite of the vision, was called Wa-k̈o*n*'-da gi-ko*n*. Gi gi-ko*n*' is to weep, from loss as that of kindred; the prefix gi indicates possession. Gi-ko*n* is to weep from want of something not possessed, from conscious insufficiency, and the longing for something that could bring happiness or prosperity. The words of prayer, wa-k̈o*n*'-da dhe-dhu wah-pa'-dhi*n* a-to*n*'-he, literally rendered are: Wa-k̈o*n*'-da here needy I stand. (A-to*n*-he is in the third person, and implies the first, as he stands, and I am he—a form of speech used to indicate humility.) While this prayer has been combined with many rites and acts, its inherent unity of name and words has been preserved through generations of varied experience and social development of the people.*

Wa-k̈o*n*'-da was a vague entity to the Omaha, but the anthropomorphic coloring was not lacking in the general conception; the prayer voiced man's ever present consciousness of dependence, was a craving for help, and implied a belief in some mysterious power able to understand, and respond to his appeal. The response came in a dream, or trance, wherein an appearance spoke to the man, thus initiating a relation between them, which was not established until the man, by his own effort, had procured a symbol of his visitant, which might be a feather of the bird, a tuft of hair from the animal, a black stone or a translucent pebble. This memento or totem was never an object of worship; it was the man's credential, the fragment, to connect its possessor with the potentiality of the whole species represented by the form seen in his vision, and through which the man's strength was to be reënforced and disaster averted.

Basis of the Efficacy of the Totem.—The efficacy of the totem was based upon the Omaha's belief in the continuity of life, a continuity which not only linked the visible to the invisible, and bound the living to the dead, but which kept unbroken the thread of life running through all things, making it impossible for the part and the entirety to be disassociated. Thus, one man could gain power over another by obtaining a lock of his hair, which brought the man himself under his influence. In the ceremony of the first cutting of the child's hair, the severed lock, which was given to the Thunder god, placed the life of the child in the keeping of the god. Again, when a man's death had been predicted—by one gifted to see into the future—the disaster could be averted by certain ceremonies which included the cutting off of a lock of hair from one side of the head, and a bit of flesh from the arm on the opposite side of the body, and casting them into the fire; by this sacrifice of a part the whole was represented, the prediction fulfilled and the man permitted to live. From the ritual of the Corn, sung when the priest distributed the kernels to indicate that the time for planting had come, we learn that these kernels were the little portions which would draw to themselves the living corn. In the ritual sung over the Sacred Buffalo Hide prior to the hunt the same idea is present, that in the continuity of life the part is ever connected with the whole, and that the Sacred Buffalo Hide was able to bring within reach the living animal itself.

Limitation in Totems.—The totem opened a means of communication between man and the various agencies of his environment, but it could not transcend the power of its particular species; consequently all actions were not equally potent. Men who

* This prayer can be seen on page 136, Song No. 73, of Vol. 1, No. 5, of the Archæological and Ethnological papers on the Peabody Museum, Harvard University.

saw the Bear in their visions were liable to be wounded in battle, as the bear was slow of movement, clumsy and easily trapped, although a savage fighter when brought to bay. Winged forms, such as the Eagle, having greater range of sight than the creatures which traveled upon the ground, could bestow upon the men to whom they came in the dream the gift of looking into the future and foretelling coming events. Thunder gave the ability to control the elements, and the authority to conduct certain religious rites.

Despite the advantages to be derived from the possession of certain totems, the inculcations given when the youth was instructed in the rite of the vision, and taught the prayer he was to sing, forbade him to ask for any special gift, or the sight of any particular thing; he was simply to wait without fear, and to accept without question, whatever Wa-k̈o*n*′-da might vouchsafe to send him. No man was able to choose his personal totem, but it was the general belief of the people that the powerful animals and agencies were apt to be drawn toward those who possessed natural gifts of mind and strength of will.

Nature of the Totems.—The totems of the Omahas referred to animals, the Bear, the Buffalo, the Deer, the Birds, the Turtle and Reptiles; to the Corn; to the elements, the Winds, the Earth, the Water and Thunder. There was nothing among them which in any way represented the human family, nor was there any trace of ancestor worship; the relation between the man and his totem did not lie along the line of natural kinship, but rested upon the peculiarities in his theory of nature, in which the will and ability to bring to pass, which he was conscious of within himself, he projected upon the universe which encompassed him. The rite of the vision was a dramatization of his abstract ideas of life and nature, and the totem was the representation of the vision in a concrete form.

THE SOCIAL TOTEM AND WHAT IT STOOD FOR IN THE TRIBE.

We have thus far seen the influence of the totem upon the individual. We are now to trace it as exerted upon groups of people; in the religious societies; in the To*n*′-wo*n*-gdho*n*, or gens; and in the development and organization of the tribe.

Religious Societies.—The totem's simplest form of social action was in the religious societies, whose structure was based upon the grouping together of men who had received similar visions. Those who had seen the Bear made up the Bear society; those to whom the Thunder or Water beings had come formed the Thunder or the Pebble society. The membership came from every kinship group in the tribe, blood relationship was ignored, the bond of union being a common right in a common vision. These brotherhoods gradually developed a classified membership with initiatory rites, rituals and officials set apart to conduct the ceremonials.

The function of the totem in the societies was intermediate between that of the individual totem and the totem in its final social office, where it presided over an artificial structure, in which natural conditions were in part overruled and the people inevitably bound together. In some of the tribes of the linguistic group to which the Omahas belong, where the political structure of the gens is apparently weak and undeveloped, the religious societies exist and are powerful in their organization. This fact, with other evidence which cannot be detailed here owing to its complex nature, together with the similarity traceable between the rituals and ceremonies of these religious societies, and those incident to the inauguration of gentile and tribal officers, makes it seem probable that the

training and experience derived from the working of these earlier societies had taught the leaders among the Omahas and their close cognates certain lessons in organization, by which they had profited during the formative period of the artificial social structure of the To*n*'-wo*n*-gdho*n*, or gens.

The Ton'-won-gdhon.—The word To*n*'-wo*n*-gdho*n* means a place of dwellings where kindred dwelt together. There were ten To*n*'-wo*n*-gdho*n* u-zhu—dominant, ruling To*n*'-wo*n*-gdho*n*, or gentes, in the Omaha tribe. These gentes practice exogomy, and traced their descent only through the father. Each gens had its particular name, which referred directly or symbolically to its totem, which was kept in mind by the practice of tabu. There was also a set of names peculiar to each gens, all having the same reference, one of which was bestowed upon each child; an Omaha's gentile name, therefore, would at once reveal his kinship group or gens. This name was proclaimed at the time of the ceremony attendant upon the cutting of the first lock of hair. After this ceremony the child's hair was cut in a fashion to symbolize the totem of its gens, and each spring, until it was about seven years of age, this peculiar trimming of the hair was repeated. The teaching of this object lesson, so placed before the children, was reënforced by their training in the strict observance of the special tabu of their gentes, holding ever before them the penalties for its violation, of blindness, physical deformity and disease.

There were religious rites peculiar to each gens in which the members did homage to the special power represented by the gentile totem. In these ceremonies the hereditary chiefs of the gens were the priests. It is easy to see why the totem was never forgotten, why its sign was borne through life, and at last put upon the dead, in order that they might be at once recognized by their kindred, and not wander as they passed into the spirit world.

Office of the Totem in the Gens.—In the early struggle for existence the advantages accruing from a permanent kinship group, both in resisting aggression and in securing a food supply, could not fail to have been perceived; and, if the people were to become homogeneous and the practice of exogomy continue, some expedient must have been devised by which permanent groups could be maintained and kinship lines be defined. The common belief of the people, kept virile by the universal practice of the rite of the vision, furnished this expedient—a device which could be understood and accepted by all—the concrete sign of the vision, the totem of the leader, he whose abilities and prowess evinced supernatural favor and won for his followers success and plenty.

From a study of the minutiæ of the customs and ceremonies within the gens, it is apparent that their underlying purpose was to impress upon the people the knowledge and the duties of kindred, and that one of the most important of these duties was the maintenance of the union of the gens. This union of kindred we find to have been guarded by the agency of the totem. The name of the gens, the personal names of its members and the practice of tabu—obligatory upon all persons, except the hereditary chiefs, while they were officiating in the gentile rites pertaining to the totem—indicate a common allegiance to a supernatural presence believed to preside over the gens by virtue of its relation to the common ancestor. These rites did not imply ancestor worship, but were a recognition of the special power represented by the totem. We also find that the gentile totem did not interfere with a man's freedom in seeking his personal totem, nor of his use of it when desiring help from the mysterious powers. The gentile totem gave

no immediate hold upon the supernatural, as did the individual totem to its possessor; outside the rites already referred to, it served solely as a mark of kinship, and its connection with the supernatural was manifest only in its punishment of the violation of tabu. Briefly stated, the inculcation of the gentile totem was that the individual belonged to a definite kinship group, from which he could never sever himself without incurring supernatural punishment.

Social growth depended upon the establishment of distinct groups and the one power adequate for the purpose was that which was believed to be capable of enforcing the union of the people by supernaturally inflicted penalties. The constructive influence of the totem is apparent in the unification of the To*n*'-wo*n*-gdho*n*, or gens, without which the organization of the tribe would have been impossible.

The Influence of the Religious Societies upon the Gens.—In the religious societies the people were made familiar with the idea that a common vision could create a sort of brotherhood. This fraternity was recognized and expressed by the observance of rites and ceremonies, in which all the members took part, setting forth the peculiar power of the totem. The influence of this training in the religious societies is traceable in the structure of the gens, where the sign of a vision, the totem, became the symbol of a bond between the people, augmenting the natural tie of blood relationship in an exogamous group. We find this training further operative in the establishment of rites and ceremonies in honor of the gentile totem, which bore a strong resemblance to those already familiar to the people in the societies. In the gens the hereditary chief was the priest, and this centralization of authority tended to foster the political development of the gens.

Related Totems.—Certain fixed habits of thought among the Omahas growing out of their theories and beliefs concerning nature and life—upon which the totem was based—present a curious mixture of abstractions and anthropomorphism, blended with practical observations of nature. Thus, in the varied experiences of disintegration and coalescing during past generations, composite gentes came into existence through the supposed affinity of totems. Out of the ten Omaha gentes, three only observe a single tabu; the other seven were composed of sub-groups, called To*n*'-wo*n*-gdho*n* u-zhi*n*ga (u-zhi*n*ga, a small part), each of which had its own special tabu, obligatory upon its own members only, and not upon the other sub-groups of the gens. While there was no common totem in a composite gens, the totems of the sub-groups which formed such gens had a kind of natural relation to each other; the objects they symbolized were more or less affiliated in the natural world, as, for example, in the Mo*n*'-dhi*n*-k̈a-ga-*h*e gens (the earth makers), where the totems of the sub-groups represented the earth, the stone and the animals that lived in holes in the ground, as the wolf.

The relation between the totems of composite gentes is not always patent; it frequently exists because of fancied resemblances, or from a subtle association growing out of conditions which have sequence in the Indian mind, although disconnected and at variance with our own observation and reason.

The Totem in the Tribal Organization.—The families within a gens pitched their tents in a particular order or form, which was that of a nearly complete circle, an opening being left as an entrance way into the the enclosed space. This encampment was called by the untranslatable name Hu'-ḑhu-ga. When the entire tribe camped together, each of the ten gentes, while still preserving its own internal order, opened

its line of tents and became a segment of the greater tribal Hu′-dhu-ga, in which each gens had its fixed unchangeable position, so that the opening of the tribal Hu′-dhu-ga was always between the same two gentes. Both these gentes were related to Thunder. That upon the right, as one entered the circle, was the I*n*-shta′-thu*n*-da—flashing eye—known as the Thunder gens or people. To a sub-group of this gens belonged the right of consecrating the child to the Thunder god, in the ceremony of cutting the first lock of hair; another sub-group kept the ritual used in filling the Sacred Tribal Pipes. On the left of the entrance camped the We′-zhi*n*-shte—a symbolic name, probably meaning the representatives of anger. The We′-zhi*n*-shte were Elk people, having in charge the Sacred Tent of War, in which the worship of Thunder, as well as all the rites pertaining to war, of which Thunder was the god, took place.

It would lead too far afield to follow at great length the inter-relations of the gentes; or the dominance of position and leadership in tribal rites and ceremonies conceded to certain gentes; or to indicate the scars left upon the Hu′-dhu-ga by the breaking away of groups of kindred; or the the devices used to keep intact an ancient form and order. The point to be borne in mind is that the position of the gentes in the tribe, and the interlacing of their functions, were regulated by the ascription of different powers to their totems, and that the unification and strengthening of the gens depended upon the restraining fear of supernatural punishment by the totemic powers.

In this rapid review of Omaha beliefs and customs connected with the totem, many observances have not even been mentioned; and of those indicated, the details have had to be omitted in order to keep strictly within the limits of our subject, but the fundamental ideas which have been briefly considered will be found to underlie all rites and ceremonies within the tribe.

Linguistic Evidence as to the Totem.—We turn now to the language for further evidence as to the import of the totem.

The name of the concrete sign of the vision is Wa-*h*u′-be, a sacred thing. The word is applied to sacred objects other than the totem, such as the Sacred Pole, the Sacred Tents, the Sacred Tribal Pipes, etc.

The name of a religious society always included the name of the manifestation of the vision of its members; for instance, the Bear society was called Wa′-tha-be i′-dha-e-dhe, literally rendered is: the Bear with or by compassion; that is, those upon whom the Bear had compassion. I′-dha-e-dhe implies that this compassion, this pity, was aroused by a human being making a personal appeal, either by his destitute appearance or the movable character of his supplication. Usage forbade the application of this word to any emotion excited by animal life; it could only express a feeling between man and man, or between man and the manifestation of Wa-k̈o*n*′-da. It did not represent an abstract idea, as of a virtue, but a feeling awakened by direct contact with need. In the prayer already cited as a part of the rite of the vision the man makes a direct appeal to Wa-k̈o*n*′-da ('Wa-k̈o*n*′-da! here needy I stand'), and reference to this act is made in the employment of the word i′dha-e-dhe in the term designating the religious societies.

The name of a gens indicated its totem or the characteristic of the group of totems in a composite gens. When the people of a gens were spoken of in reference to their totem the word i′-ni-ka-shi-k̈i-dhe was used immediately following that of the totem; for instance, the Thunder people—the I*n*-shta′-thu*n*-da gens—were called I*n*-gdha*n*-i′-ni-ka-shi-k̈i-dhe; i*n*-gdha*n*′, thunder; i′-ni-ka-shi-k̈i-dhe is a composite word,

meaning: they make themselves a people with; that is, with thunder they make themselves or become a people. The We′-zhi*n*-shte gens, the Elk people, were called O*n*-pa i′-ni-ka-shi-k̈i-dhe—o*n*-pa, elk; with the Elk they make themselves a people. The word i′-ni-ka-shi-k̈i-dhe clearly indicates the constructive character of the totem in the gens.

The set of names which belonged to each gens referred to the sign or totem of a family group; these names were called ni′-ki-e—spoken by a chief, or originated by a chief. The word ni′-ki-e points to the formative period when means were being devised to transform the family into a distinct political group; it argues a central authority, a man, a chief; the individual names which he bestowed allude solely to the power behind the chief, the manifestation of his vision represented by his totem, in the favor of which he and his kindred had made themselves a people, i′-ni-ka-shi-k̈i-dhe.

The Osage equivalent of the Omaha word i′-ni-ka-shi-k̈i-dhe is zho′-i-ga-ra, meaning associated with. The Otoe word used for the same purpose is ki′-gra-jhe, they call themselves.

The word for tribe u-k̈i′-ẗe, when used as a verb, means to fight, to war against outside enemies, indicating that the need of mutual help impelled the various To*n*′-wo*n*-gdho*n* (gentes) to band together for self-preservation; but the order of their grouping was, as we have seen, controlled by their totems.

Summary.—In the word for tribe, in the formation of the gens within the tribe, and in the rite which brought the individual into what he believed to be direct communication with Wa-k̈o*n*′-da, we trace the workings of man's consciousness of insecurity and dependence, and see his struggles to comprehend his environment and to bring himself into helpful relations with the supernatural. And we find in this study of the Omaha totem that, while the elements, the animals and the fruits of the earth were all related to man through a common life, this relation ran along discrete lines, and that, his appeal for help once granted, relief could only be summoned by means of the Wa-*h*u′-be, the sacred object, the totem, which brought along its special line the desired supernatural aid.

It is noteworthy that the totems of individuals, as far as known, and those of the gentes, represented the same class of objects or phenomena, and as totems could be obtained in but one way—through the rite of the vision—the totem of a gens must have come into existence in that manner, and must have represented the manifestations of an ancestor's vision, that of a man whose ability and opportunity served to make him the founder of a family, of a group of kindred who dwelt together, fought together and learned the value of united strength.

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*MULTIPLE-CYLINDER STEAM-ENGINE.**

The following is a very brief abstract of the paper presented to the American Society of Mechanical Engineers, by Messrs. Thurston and Brinsmade, at the last convention, New York, Deceber 2, 1897:

The paper was a statement of the results of the experimental investigation of the relative efficiency of standard forms of compound and triple-expansion engines and a newly introduced type in which the high-pressure cylinder is given about one-half the size ordinarily assigned for a stated power, as compared with the magnitude of the low-pressure cylinder. Remarkably

*Presented at the New York meeting (December, 1897) of the American Society of Mechanical Engineers, forming part of Volume XIX. of the *Transactions.*

high efficiencies had been reported and it had become important to ascertain what relation the new sustained to the old system. The machines employed in the research were, in fact, the available combinations of of the largest of the triple-expansion 'experimental engines' of Sibley College, and the combinations adopted were:

1. The triple-expansion engine in its usual condition.

2. The intermediate- and the high-pressure elements combined to make a compound engine of usual proportions—three to one.

3. The low- and the high-pressure elements combined to produce a compound of the peculiar sort above mentioned—seven to one.

Earlier reports upon the performance of engines of these several types had been made to the same Association and the results so reported had been as below; the second of the three cases illustrating the novel practice which it was here sought to study:

several types of engine. Taking the best performance of the ideal engine as varying as the logarithm of the pressure employed, as also found by experience to be approximately the fact with good engines, the gain to be fairly anticipated by adopting the higher pressure, other things being equal, should be such as to give the figures 11.8, 12.84 and 11.16 pounds of feed-water per horse-power per hour, for the three cases respectively. The relative efficiency will then be expressed by the figures 0.95, 0.87, 1.00. The engine of usual type, as a compound, when well-designed and built, thus gives a performance within 5 per cent. that of the best known triple-expansion engine; the compound, with exaggerated cylinder-ratio, lacks 13 per cent. of the efficiency of the triple-expansion and 7 per cent. that of the standard type of compound. Leavitt's Chestnut Hill engine, for which the figure 11.2 is reported, may be taken as identical with the Reynolds pumping engine in relative efficiency; correction being made for

CASE OF COMPOUND *vs.* TRIPLE AND INTERMEDIATE FORMS.

Engine.	Standard Compound.	Intermediate Form.	Triple Expansion.
Number of cylinders in series	2	2	2
Steam-pressure, absolute	151.6	175.5	135.5
Vacuum, in. mercury	27.75	25.3	27.6
Ratio of expansion	20.40	33. (nom.)	19.55
Revolutions per minute	18.57	76.4	20.31
Length of stroke, ft	10.0	4	5
Piston speed, per minute, ft	371.5	611.2	203
Cylinder-ratio	4	7	1, 3, 7
Drop between cylinders	None	14 lbs.	None
Dry steam, per I. H. P. per hr	12.156	12.84	11.678
Difference favoring compound	0.684 lbs. = 5.3%		
Difference in favor of triple	0.478 lbs. = 4%	1.16 lbs. = 9%	
	a	*b*	*c*
St. cons. reduced to 175 lbs	11.8	12.84	11.16
Comparative effic. on this basis	0.95	0.87	1.00

The table contains, in the last two lines, figures added to bring into more perfect comparison the relative economy of the difference in pressures. Were correction made for differences in ratios of expansion, the result above indicated would

have been somewhat more marked, as the engine of novel proportions has, nominally at least, 65 per cent. higher ratio than its rivals; but, as a considerable part of this apparent expansion-ratio measures free expansion without performance of work, the comparison on this basis would not be strictly correct. No correction is attempted for differences in speeds of piston or of revolution, on which score the intermediate type of engine would apparently have a very marked advantage; for, as was long ago pointed out by the writer, where jacketing is adopted successfully, variation of piston-speed seems to have little effect on economy.

The three experimental engines being compared, as proposed, and as indicated in the introductory paragraph, the novel proportions are found, in this case also, to give an efficiency intermediate between the standard compound engine and the standard triple-expansion under similar steam-pressures.

The following table shows the conditions during the most efficient periods of test of the three systems:

test of the triple and the most economical test of the 7-to-1 compound there is a difference of an inch and a half of mercury in the vacuum, and of four pounds in the boiler pressure. The column showing the three tests reduced to a common back-pressure was obtained by increasing or diminishing the mean effective pressure in the low-pressure cylinder of each by the amount each varied in back-pressure from that of the required mean. In this case the mean was taken as the back-pressure in the triple-expansion test. This correction brings the triple and 7-to-1 compound nearer together, but we shall still have a difference in steam consumption of 1.48 pounds of steam per horse-power per hour between the triple and the 7-to-1 compound, and a difference of 2.1 pounds between the latter and the compound with the 3-to-1 ratio of cylinder volumes.

The performance, absolute and relative, of these three engines with varying power is illustrated in the accompanying diagram, which well exhibits the curious variation of relation, in this respect, produced by changing conditions of operation.

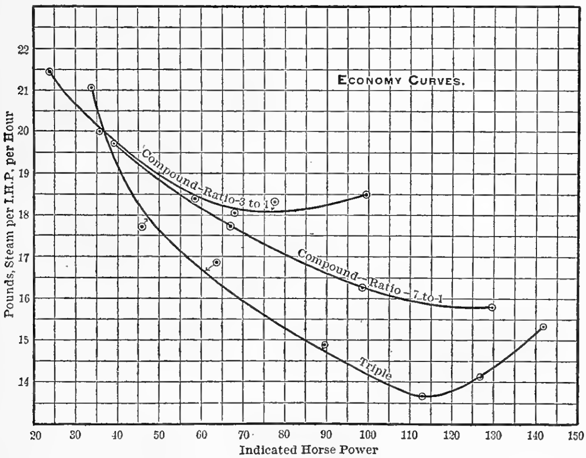
Comparison of the Most Economical Trials.

	Triple.	7-to-1 Compound.	3-to-1 Compound.
Boiler gauge	119.1	115	117.5
Revolutions per minute	84.95	87.65	85.52
Vacuum in inches of mercury	24.3	22.84	22.7
Condensed steam in pounds	1,205	1,753.7	1,030
Total jacket-water	335.4	316.7	190.97
Total steam used	1,540.3	2,070.4	1,221.2
Total I. H. P.	112.65	129.97	67.7
Distribution of work between cylinders, H. P. = 1	I. C. = 1 L. P. C. = 1	1.29	.635
Mechanical efficiency	84.1	86.6	90
Steam per I. H. P. per hour	13.68	15.8	18.03
Number of expansions	22	18.89	15.45
Steam per I. H. P. corrected to a vacuum of 24.3 inches mercury	13.68	17.1	17.3

It will be noticed that in the triple-expansion tests both the vacuum and the boiler pressure are better than in either of the others. Between the most economical

The curves in this figure leave no room for doubt in regard to the relative economy of the three engines. At about 37 horsepower the steam consumption in each case

is about the same. The curves then diverge, the 3-to-1 compound reaching a minimum steam consumption at 75 horse-power, of 18 pounds. The minimum points on the other curves, owing to their larger low-pressure cylinder volume, lie further along, and are 15.8 pounds for the 7-to-1 compound, and 13.7 pounds for the triple-expansion engine. We have thus a gain of 2.2 pounds of steam per indicated horse-power per hour of the 7-to-1 over the 3-to-1 compound, and a gain over the former by the triple-expansion engine of 2.1 pounds of steam per indicated horse-power per hour.



EFFICIENCY OF MULTIPLE-CYLINDER ENGINES.

Comparing the best work of each type, as given by the records to the date of the preparation of this paper, the best work of good engines of each class may be taken as, approximately, measured by the weights of steam, per horse-power per hour, or by the number of thermal units, proportional to the reciprocal of the logarithm of the pressure adopted. Thus, the following are given as the relative efficiencies of these three engines, in terms of steam demanded, or of weight of feed-water consumed per horse-power per hour:

For the triple-expansion engine, $$W = \frac{24}{\log p} \quad (1)$$

For the standard compound, $$W = \frac{27}{\log p} \quad (2)$$

For the special form of compound, $$W = \frac{29}{\log p} \quad (3)$$

"The latter is seen, on examination of its proportions, to be a form of engine designed for an abnormally high total ratio of expansion at the proposed pressure, and assigned an abnormally heavy load; so that when actually in action under its average load it must work with a low ratio of expansion in the high-pressure cylinder, and must exhibit an abnormally large 'drop' at its exhaust."

The outcome of the investigation is that it is concluded that this novel, intermediate form of multiple-cylinder engine is also intermediate in its economical performance

between the standard compound and standard triple-expansion engines, sometimes so closely related to the latter that it becomes a question whether the third cylinder of the more complex machine may not be profitably dispensed with. This question will be answered in the negative or in the affirmative, apparently, accordingly as the costs of fuel are small or large, relatively to the costs of the possibly superfluous cylinder. With variable loads, also, the new type or proportion of engine is found to give indications of possessing some special advantages.

Referring to the principles which must control in any attempt to approximate more closely to the best possible thermodynamic employment of heat-energy, as transformed in the steam-engine, the following are given as the conclusions of the writers of the paper, as the essential guides of the engineer designing economical forms of steam-engine.

The Requisites of Maximum Thermodynamic Efficiency with Constant Load are:

(1) A steam distribution approaching most closely the ideal of Carnot; or, assuming the cycle of Rankine to be that in which the machine is constructed to act, the closest possible approximation to the ideal conditions of distribution for that cycle.

(2) As nearly as practicable, a non-conducting cylinder, or its equivalent, a non-heat-transferring working fluid, insuring, approximately, at least, adiabatic action, so far as heat transfers between working fluid and enclosing walls are concerned.

(3) Maximum possible range of pressure and temperature during expansion.

The Requisites for Maximum *Total* Efficiency are the above, together with:

(4) Minimum friction of engine and heat-losses.

(5) Limitation of the expansion-range by that volume at which the expansion line meets the line, parallel with the back-pressure line, marking the sum of the useless resistance of the machine *plus* that added quantity which is a fraction of the mean effective pressure equal to the ratio of the steam and heat wastes, internally and externally, due extra thermodynamic causes, to the total steam and heat supply.

The Requisites for Maximum *Commercial* Efficiency are, further:

(6) Such an adjustment of the proportions and of the steam-distribution of the engine that any change would cause a larger loss in the dividend account than would be saved by better conditions in the direction in which improvement was sought.

PREHISTORIC QUARTZITE QUARRIES IN CENTRAL EASTERN WYOMING.

In July, 1894, while our scientific expedition was passing through eastern central Wyoming, we came upon some prehistoric quarries, which, owing to their number and extent, are of more than usual scientific interest. They are located some forty or fifty miles north and east of Badger, a station on the Cheyenne and Northern Railroad, one hundred and twenty-five miles north of Cheyenne. There are no roads or trails leading to this discovery, but the old overland trail, following the north side of the North Platte River, passes some four or five miles west of the largest quarries. The drainage from the quarries is to the northward, into Muddy Creek, which flows westward to the Platte River. In the vicinity of the quarries the stream is dry, and water is found running only in the spring and during heavy rains. The country about is very arid, and there is but a scanty supply of both water and vegetation.

Passing through this region from the northeast to the southwest is a very prominent bluff, with precipitous slopes facing

the north. The bluff is five or six miles in length, and scattered along nearly its entire distance are the quarries of various sizes and shapes. The bluff has been caused by a fault which brought the Dakota sandstone to the surface. This sandstone has been metamorphosed into a great variety of quartzites. In color they shade from white to nearly black, and from a light pink to a dark red. They are very fine grained and work so easily by chipping that a novice can make a very good-looking implement in a few minutes.

In the preliminary examination, which was necessarily very limited, nineteen openings were visited. The nature of the openings varied so much that it has been thought best to classify them as follows: 1. Superficial; work of great surface extent where exposed blocks of quartzite have been dug up. 2. Shallow quarries; which are quite extensive, but have not been worked to a depth of more than two or three feet. 3. Deep quarries; worked to a depth, varying from fifteen to twenty feet or more. 4. Tunnels; but one of this class was seen. 5. Shafts; resembling the modern mining shaft, but not appearing to be very deep. All of the work has been done in a very systematic manner, and does not resemble the ordinary quarries so common in Wyoming, and from which the Indians secured most of the material to manufacture implements. In place of delving here and there, these quarrymen opened a quarry along the outcropping quartzite and worked it into the bluff, or dug a hole deep enough to reach the valued stone. In all the openings they had evidently maintained a clean face to work on. The refuse rock was carried back as by modern quarrymen. In fact, one could easily imagine that these quarries were old modern ones.

The largest quarries are located near the center of the bluff and near a very small spring. A description of the largest of this group will give a general idea of the excavations. It covers several acres of ground which slopes gently to the north and east. The workmen had commenced the excavation on a point, but when operations were suspended the quarry face was several hundred feet wide. The ground that has been worked over is covered with irregular mounds of refuse, which in the majority of cases is grass grown. In exposed places, where the wind has had free access, the refuse heaps are as the quarrymen left them. No fragments of rocks were seen that would make a heavy load for one man to carry. Near the old quarry face, which in most places was entirely obliterated, and where the fragments of rock have not been covered with the drifting sand, there were

FIG. 1.

numerous circular depressions. These had been made with rock fragments, and were from two to three feet in diameter and from twelve to sixteen inches in depth. Within these depressions were numerous roughly formed implements. These pits were beyond question collecting places for the quarrymen, and the pieces left behind were rejected on account of some defect. Near the old quarry face some enthusiastic prospector has in recent years sunk a shaft, probably in search of gold. This shaft, although partly caved, was nearly twenty feet deep. On one side rock in place could be seen, but the shaft had been sunk in the débris.

The implements found about the quarries were unusually large and rudely made. No finely finished implements of any kind were found. The hammers and mauls were all made from boulders of quartz and granite that had been brought from the neighboring mountains, some twenty miles away. With the exception of the mauls and hammers, all of the implements found were made of quartzite. Spear points, scrapers, axes and anvils were all of the implements found that have been classified. The axes are exceptionally rude, and according to Dr. Wilson, of the Smithsonian, are the first reported from the Rocky Mountains. Some three hundred implements were collected. For some distance about the quarries the ground was strewn with chips and fragments of quartzite, but in no instance were any heaps of chips and refuse, as are usually seen where the implement maker has labored.

There were no signs of any habitation except the tepee rings, which were scattered all around the quarries, in valley and on hill alike. No burial places were found. On the northeast slope, leading from the largest quarry, the workman left a very peculiar figure. It faces the east, and has been made by arranging fragments of rock along the ground. There were circular piles of stone at either end of the figure. (See Fig. 2.)

Fig. 2. — *aa*, piles of stones; *b*, circle; length about eighty feet.

The most striking points associated with these quarries are as follows: The vast amount of work done, the absence of chip heaps, the rude nature of the implements and their great size. All estimation of the tonnage of rock moved must be left for some future investigation. Suffice it to say that it will be estimated by the hundreds of thousands, if not by millions, of tons. The absence of chip heaps leads one to suppose that the quarrymen carried the quartzite away to manufacture. Which, if true, would signify that these quarries were neutral ground where the aborigines from all quarters worked for the implement stone, and that they took it to their respective haunts to work up. The unusual positions of many of the tepee rings also strengthens this supposition. Quartzite implements made from quartzite resembling that quarried from this region are very common on the plains and in the mountains. The rudeness of the implements can not be explained satisfactorily at this time. It might have been due to the age in which they were made, or it may be possible that only rejected implements have been found. The size is, no doubt, due to the nature of the stone. It would make a large implement, but possibly not a small one.

The quarrymen must have been the aborigines, but unlike the Indians of modern times, they must have been laborers, and have worked for centuries to have accomplished so much, with the very crude tools that they used. Who they were will never be known. The trails over which they traveled are entirely obliterated, and most of the quarries are covered with drift-

ing sand and overgrown with the scanty vegetation of an arid region.

Central eastern Wyoming is a very noted place for prehistoric quarries, but as a rule they are small and very shallow and are in no way comparable to the recent discovery. Usually the Indians have worked for jasper and agate and have dug irregular openings that do not represent systematic development. Quartzite quarries are extremely rare and these are by far the largest that have been reported from Wyoming.

WILBUR C. KNIGHT.
UNIVERSITY OF WYOMING,
LARAMIE, December 30, 1897.

ASSOCIATION OF AMERICAN ANATOMISTS.

UPON the invitation of Cornell University, the Association met at Ithaca, N. Y., December 28–30, 1897. Morning and afternoon sessions were held on each of the three days excepting Wednesday, when all the affiliated societies met in the afternoon with the American Society of Naturalists. Notwithstanding the small attendance the sessions were fully occupied with reports, papers and discussions, and several papers were read by title for lack of time.

After a brief introductory by the President, Dr. Frank Baker, Dr. B. G. Wilder read an obituary notice of Dr. Harrison Allen, one of the founders and Presidents of the Association. The report of the Secretary-Treasurer, Dr. Lamb, showed that there were 105 active and 4 honorary members. Dr. Allen, and Dr. Wm. Laurence Dana, of Portland, Me., had died and Dr. P. J. McCourt, of New York City, had resigned. Beginning with the present year the annual dues are three dollars.

The circular and blanks in reference to the anatomical peculiarities of the negro race were ordered to be modified and copies sent out for report of cases.

The Association adopted the report of the majority of the Committee on Anatomical Nomenclature, and ordered it to be published and distributed as soon as practicable, accompanied by the objections of the minority of the Committee, and comments thereon by the Secretary of the Committee. Of the neural terms recommended, more than 100 were identical with those adopted in 1895 by the Anatomische Gesellschaft.

The following papers were read and discussed; they were illustrated by specimens, photographs and diagrams:

Dr. P. A. Fish, Ithaca, N. Y.: 'A fluid for the retention of natural colors of anatomical specimens' and 'Mummification of small anatomical specimens.'

Dr. George S. Huntington, New York City: 'Comparative anatomy and embryology as aids to the teaching of human anatomy in the medical course.'

Dr. B. G. Wilder: 'An adult and healthy living cat, lacking the left arm, excepting the scapula and having the heart apparently at the epigastrium.'

Dr. Woods Hutchinson, Buffalo, N. Y.: 'Relative diameters of the human thorax.'

Dr. D. S. Lamb, Washington, D. C.: 'Pre-Columbian syphilis.'

Mr. Charles H. Ward, Rochester, N. Y.: 'A craniomandibular index.'

Professor Howard Ayers, University of Missouri: 'The membrana basilaris, membrana tectoria and nerve endings in the human ear.' Read by Dr. Hopkins.

Dr. Wilder: 'Certain resemblances and peculiarities of the human brain.'

Dr. B. B. Stroud, Ithaca, N. Y.: 'The ape cerebellum.'

Dr. Fish: 'The brain of the fur-seal, *Callorhinus ursinus.*'

Dr. Huntington: 'The eparterial bronchial system of mammalia.'

Dr. J. A. Blake, New York City: 'The relation of the bronchi to the thoracic wall.'

Dr. Thomas Dwight, Boston, Mass.: 'The distribution of the superior mesenteric artery.' Read by Dr. Lamb.

Dr. D. W. Montgomery, University of California, San Francisco: 'Sebaceous glands in the mucous membrane of the mouth.' Read by Dr. Lamb.

Dr. Stroud: 'Notes on the appendix.'

Professor S. H. Gage, Ithaca, N. Y.: 'On the relation of the ureters in the cat to the great veins, with variations.'

Dr. Wilder: 'A number of specimens of either unusual or specially instructive character.'

Mr. H. A. Surface, Fellow in Cornell University: 'Notes on the fish fauna of Cayuga Lake.'

The following papers were read by title:

Professor George A. Dorsey, Chicago: 'Description of two Koutenay skeletons' and 'Two examples of unusual ossification of the first costal cartilages.'

Dr. E. R. Hodge, Washington, D. C.: 'Relation of sex to the size of the articular surfaces of the long bones.'

Dr. J. T. Duncan, Toronto, Canada: 'Anus vulvalis.'

Dr. Woods Hutchinson: 'A skin heart.'

The following officers were elected for the ensuing term: Dr. B. G. Wilder, Ithaca, N. Y., President; Dr. Geo. A. Piersol, Philadelphia, First Vice-President; Dr. William Keiller, Galveston, Texas, Second Vice-President; Dr. D. S. Lamb, Washington, D.C., Secretary and Treasurer.

Dr. F. J. Brockway, of New York City, Delegate, and Dr. R. W. Shufeldt, of Washington, Alternate, to Executive Committee of Congress of American Physicians and Surgeons.

Dr. F. J. Shepherd, of Montreal, Canada, member of the Executive Committee of the Association, in place of Dr. Huntington, term expired.

The following eminent anatomists of the Old World were elected honorary members: Dr. Mathias Duval, Paris; Dr. Carl Gegenbaur, Heidelberg; Dr. Wilhelm His, Leipzig; Dr. Albert von Kölliker, Wurzburg; Dr. Alexander Macalister, Cambridge; Dr. L. Ranvier, Paris.

It is understood that the next meeting will be held in New York City, in the Christmas Holidays, in conjunction with the Society of Naturalists and other affiliated societies.

D. S. LAMB,
Secretary.

CURRENT NOTES ON ANTHROPOLOGY.

SOUTH AMERICAN ETHNOGRAPHY.

THE praiseworthy industry of linguists in South America is rapidly dispelling the uncertainty which has so long hung over the affiliations of tribes in that continent. Their recent labors merit a much fuller notice than can here be given, but they must at least be named.

Two articles by Samuel A. Lafone Quevedo deserve especial mention. One is, indeed, a volume of nearly 400 pages, with map, etc., on the tongue of the Abipones (in the Boletin of the National Academy of Cordoba, Vol. XV.); the other is on the dialects of the Chanases and their neighbors (in the Boletin of the Geog. Inst., Tom. XVIII.). Both are excellent pieces of work.

Dr. Rodolfo Lenz has continued his thorough investigations of the Araucanian idiom by a series of pieces in the Pehuenche and a number of songs in that and the Moluche dialects (in the Anales of the University of Chile, Tom. XCVII.); and an instructive popular lecture on Araucanian literature, printed in the *Revista del Sur.*

A very fine monograph, ethnographic and linguistic, is that on the Matacos by Juan Pelleschi (pp. 248, with two maps, printed in the Boletin of the Geographical Institute, Buenos Aires). It is accurate, original and exhaustive.

LIVING TRIBES IN THE STONE AGE.

IN a few remote corners of the earth there are yet tribes in the full Stone Age, living under the conditions of early neolithic man in Europe. Von den Steinen found such at the head waters of the Xingu; the Jesuits not long ago discovered such in the interior of Alaska; and a report has lately been published by the La Plata Museum of the Guayaquis, who dwell in Paraguay, near the head waters of the River Acaray, and who are alleged to be true Stone Age people. They are not over 500 or 600 in all, and are a timid, harmless set, shunning the whites from whom they have never received anything but brutal treatment. Their arms are the bow, the lance and the stone toma-

hawk. They wear tall caps of tapir skin and adorn their necks with strings of bones and teeth. They are somewhat undersized, prognathic and brachycephalic.

Strange to say, their language was not studied, the small vocabulary given, which is Guarani, being probably a blunder. Dr. Ehrenreich, from whose article in *Globus* I borrow the notice, inclines to believe them allied to the Botocudos.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

THE act of incorporation of the Washington Academy of Sciences states that its object is the promotion of science with power:

a. To acquire, hold and convey real estate and other property, and to establish general and special funds.

b. To hold meetings.

c. To publish and distribute documents.

d. To conduct lectures.

e. To conduct, endow or assist investigation in any department of science.

f. To acquire and maintain a library.

g. And, in general, to transact any business pertinent to an academy of sciences.

The nucleus of 75 members elected by the Joint Commission held the first meeting of the Academy on February 16th, when officers were elected as follows: *President*, J. R. EASTMAN; *Secretary*, G. K. GILBERT; *Treasurer*, BERNARD R. GREEN; *Managers*, Alexander Graham Bell, Frank Baker, F. W. Clarke, C. Hart Merriam, H. S. Pritchett, George M. Sternberg, Charles D. Walcott, Lester F. Ward and Carroll D. Wright. The seven Vice-Presidents will be nominated by the seven affiliated societies—Anthropological, Biological, Chemical, National Geographic, Geological, Entomological and Philosophical. The nucleus of 75 will probably be considerably enlarged at the next meeting by the addition, as original members, of persons nominated by a committee appointed for that purpose at the last meeting.

THE New York Academy of Sciences held its annual meeting on February 28th, when the retiring President, Professor J. J. Stevenson, made an address on 'The World's Debt to Pure Science.' The following officers for the ensuing year were elected: *President*, HENRY F. OSBORN; *1st Vice-President*, NATHANIEL L. BRITTON; *2d Vice-President*, JAMES F. KEMP; *Corresponding Secretary*, RICHARD E. DODGE; *Treasurer*, CHARLES F. COX; *Librarian*, ARTHUR HOLLICK.

THE New York Zoological Society has secured the $100,000 needed to enable it to take possession of the site provided by the city for a Zoological Garden. The total amount subscribed is $103,550. There have been thirteen $5,000 subscriptions by Levi P. Morton, W. K. Vanderbilt, Oswald Ottendörfer, Percy R. Pyne, William E. Dodge, Robert Goelet, J. Pierpont Morgan, Jacob H. Schiff, William D. Sloane, William C. Whitney, C. P. Huntington, Henry A. C. Taylor and George J. Gould. According to the terms of the agreement between the Society and the city, as effected last year with the Commissioners of the Sinking Fund, the Society is under obligation to raise $250,000 for buildings and collections, of which sum $100,000 must be in the Society's treasury on or before March 24, 1898, and it was agreed that the Society could not take possession of the site until that amount had been provided.

WE regret to learn that Professor W. A. Rogers, the physicist, is dangerously ill.

DR. RUDOLF LEUCKART, professor of zoology at Leipzig, died on February 7th at Leipzig, at the age of seventy-four years.

WE also regret to record the death of Professor Knud Styffe, Director of the School of Technology at Stockholm, and of M. P. B. L. Verlot, the botanist, at Verrières-les-Brusson.

THE Paris Academy of Sciences has passed resolutions expressing regret at the death of the publisher Jean-Albert Gauthier-Villars and their appreciation of the value to science of his services in publishing works such as those of Lagrange, Fermat, Fourier, Cauchy and others.

IT wished to raise by international subscription a fund for a memorial to the late Edmund Drechsel, the eminent physiological chemist, and for the education of his two sons. Subscriptions may be sent to Professor Kronecke, University of Berlin.

A MEMORIAL will be erected in the chemical laboratory of Bonn to August Kekulé, who for-

nearly thirty years was professor of chemistry at Bonn. Contributions may be sent either to the Treasurer of the German Chemical Society, Dr. J. F. Holtz, Müllerstrasse, Berlin, N.

THE will of the late Dr. Harrison Allen bequeathes his valuable collection of mammals to the Academy of Natural Sciences of Philadelphia.

DR. E. C. SEGUIN, the pathologist and neurologist, who died recently in New York, has, by his will, given his instruments and books to Columbia University and the New York Academy of Medicine.

WE learn from *Nature* that the German Emperor, as King of Prussia, has conferred upon Dr. John Murray, Director of the Scottish Marine Station, and formerly of the *Challenger* expedition, the rare distinction of knighthood in the Order *Pour le Mérite*, founded by Frederick the Great. This is generally allowed to be the highest honor which a man of science can receive, and is limited to thirty German and twenty-five foreign knights. Lord Kelvin, Lord Lister and Sir G. G. Stokes are the only other British men of science now alive who have received the Order. Dr. Murray has also been elected a Foreign Member of the Imperial Russian Academy of Sciences.

M. FRANCHET has been elected President of the Botanical Society of France.

IN connection with the completion of his 25th year of office as Woodwardian professor of geology at Cambridge, it was proposed to present Professor T. M'Kenny Hughes with an illuminated address, to be presented at a public dinner held in London on the 26th of February. Sir Archibald Geikie has consented to preside.

PROFESSOR O. MATTIROLOT has been appointed Director of the Botanical Garden and Museum of Florence.

THE tenth Congress of Russian Men of Science and Physicians will be held at Kieff from August 21st to 30th, under the presidency of Professor J. Rachmaninow.

THE third Congress of the Italian Geographical Association will meet at Florence, beginning on April 12th. The quarter centenary of the discoverers Toscanelli and Vespucci will be celebrated as part of the proceedings of the Congress.

THE twenty-seventh Congress of the German Surgical Society will be held in Berlin, from April 13th to 16th, under the presidency of Professor Trendelenburg, of Leipzig. In connection with the Congress there will be an exhibition of preparations, instruments, etc., and a display of Röntgen photographs.

AN International Congress on Commercial Education will be held at Antwerp on April 14th–16th, with the Belgian Ministers of Foreign Affairs and Industry as Honorary Presidents. The Congress is especially designed to give to business men, to teachers of commercial subjects, and to representatives of central and local educational authorities, an opportunity of discussing the curriculum and methods which should be adopted in commercial schools of different grades. Further information can be obtained from the Secretary of the Congress, Monsieur Emile Roost, 120 Boulevard Léopold, Antwerp.

PRESIDENT MCKINLEY has appointed and commissioned J. W. Collins, of Massachusetts, to represent the United States at the International Fisheries Exposition, to be held in Bergen, Norway, from May to September of this year.

THE 51st annual meeting of the Institution of Mechanical Engineers was held recently in the hall of the Institution of Civil Engineers, Great George Street, Westminster. The chair was occupied during the earlier portions of the proceedings by Mr. E. W. Richards, the retiring President, who introduced Mr. Edgar Worthington, the newly-elected Secretary, to the meeting. The report stated that at the end of last year the number of names on the roll was 2,496, as compared with 2,359 at the end of the previous year. During 1897 227 names were added, the loss by death being 30, and by resignation or removal 60. The receipts during the year were £7,656, and the expenditure £6,202. The total investments and other assets amounted to £72,329, and after deducting therefrom £25,000, due on debentures and other sums, the capital amounted to £44,229. It was proposed to hold this year's summer meeting of the Institution at Derby. The result of the ballot for the

election of the Council was announced, Mr. S. W. Johnson being elected President, and Mr. Arthur Keene and Sir William White, Vice-Presidents.

A MAGNETIC observatory with an excellent equipment has been recently fitted up in the Parc Saint-Maur, Paris. But M. Mascott was compelled to announce recently at the Paris Academy that the City Council had given permission to an electric railway to pass near the observatory, which will entirely destroy its usefulness.

Nature states that on December 18, 1897, a hall was opened at Bologna for the reception of the herbaria, preparations and sections of the botanist Aldrovandi. It has been erected at the cost of the city and province.

THE bacteriological laboratory established in Constantinople by Pasteur at the request of the Sultan has been reopened after a period of neglect. This action has been taken after protests by the Imperial Society of Medicine and the French Chargé d' Affairés. It is said that the work of the laboratory will now be extended under Dr. Nicole.

MME. EMILE DURAND has given $7,500 to the Pasteur Institute for the purpose of making further researches on tuberculosis. The donation has been accepted.

THE weekly mortality for the plague at Bombay is now over 1,000, while the total number of deaths is over 2,000. The rate of the city is 120 per thousand inhabitants.

THE item in the Sundry Civil Appropriation Bill under consideration at Washington provides $520,000 for the representation of the United States at the Paris Exposition of 1900. Germany proposes to spend about $1,250,000, and the English government has announced its intention of asking an appropriation of $375,000. A Royal Commission to provide for the representation of Great Britain has been appointed, which includes Lord Kelvin, Lord Lister, Sir John Lubbock and other men of science.

AN amendment to the Sundry Civil Service Bill authorizes the holding of a National Exposition of American Products and Manufactures, especially suitable for export, in Philadelphia in 1899. The amendment carries an appropriation of $350,000, of which $300,000 is to be used to provide buildings for the Exposition and the remaining $50,000 to be expended in collecting exhibits.

THE party that has been collecting specimens of natural history in the Galapagos Islands, on behalf of the Frank Blake Webster Company, of Hyde Park, Mass., have returned, having, it is said, secured valuable collections.

THE *Publisher's Weekly* gives details of the books published in the United States during 1897. The number of new books was 4,171, being 1,018 fewer than in 1896. The decrease has been especially noticeable in fiction, belles-lettres and political science. There was, however, an increase in 'physical and mathematical science,' which apparently includes the natural sciences, the number of new books being 166, as compared with 136 in 1896.

THE F. A. Stokes Company will publish in April an account of Lieutenant Peary's seven arctic expeditions.

THE *Osprey*, the first volume of which was published at Galesburg, Ill., has been removed to New York City, the offices being at 141 East 25th Street.

THE Maryland State Historical Society was organized at Baltimore on January 26th, and the following officers were elected: President, Charles G. Biggs, Sharpsburg; Vice-President, Captain R. S. Emory, Chestertown; Secretary and Treasurer, James S. Harris, Kent county. Vice-Presidents were chosen by the delegates from the twenty-three counties of the State, thus giving a complete representation. A Legislative Committee, composed of J. P. Blessing, C. L. Rogers, E. A. Pry, Henry Brown and W. A. Shipley, was authorized to petition for an appropriation of $500 annually to aid in its work. The first business to come before the organization was the report of the Legislative Committee appointed by order of the convention. The chief recommendations of the report were as follows: "To provide for the formation of a Maryland State Horticultural Department; to protect the horticultural interests of the State of Maryland in the suppression and ex-

termination of the San José scale, peach yellows, pear blight and other injurious insect pests and plant diseases, and to create the offices of State Entomologist, State Vegetable Pathologist and State Horticulturist, and to appropriate a sum of money therefor. The professors of entomology, vegetable pathology and horticulture of the Maryland Agricultural College and the Experiment Station shall be the State officers and the department shall be under the control of the State Agricultural College, to whom the State officers shall be responsible. Notice, in writing, of infection is to be given to owners, and if not attended to after ten days the State officers shall act and the cost be added to the tax bill and collected as is other taxation. All nurseries of the State are to be inspected at least once in six months, and where found apparently free from insect pests and disease the owners shall be given certificates to such effect. Both Entomologist and Pathologist must make an annual report of inspection to the Governor of the State, this to be published as a Bulletin of the Experiment Station. The appropriation asked for carrying this into effect is $8,000 for the first year and $6,000 for each year after. Attention was also called to the 'clause' in the Game Law, which will permi boys to shoot robins, larks, doves and flickers at any time, and a resolution was unanimously adopted that 'members of the State Legislature be invoked to reject that section of the resolution which refers to these birds;' also, that the insectivorous birds shall be named, and their being killed or offered for sale shall be counted a misdemeanor and made punishable by fine.''

The Electrical World gives a summary of a report in the *Elektrische Zeitschrift* of the work in electricity of the German Reichsanstalt during the past two years. Much work was done in connection with the standard ohm, and this may now be considered concluded, the determination of the ohm for that institution being now assured. Comparisons were made to determine the constancy of the wire and mercury secondary standards; these have been repeatedly compared, and gave very good results, as before; those of wire are almost all of manganin and show that this material, besides having a very small temperature coefficient, has a very good constancy, and is therefore well suited for exact measurements. Under standard cells it is stated that both the Clark and Weston cells were carefully examined, and the previous results were confirmed that the cells are constant and reproducible to 1 in 10,000; the dependence of the voltage of the cadmium cell on the composition of the amalgam was also investigated, also the effect of warming the cells. An absolute determination of the Clark cell was made with the Helmholtz electro-dynamometer, it being a repetition of the previous one; the results differed by less than 1 in 1,000 from the values obtained with the silver voltameter and showed that the absolute measurements of current agreed with those made by other methods. The determination of the E. M. F. of the Clark cell with the silver voltameter showed the difficulties involved, and if these are not taken into account the results are uncertain to 1 in 1,000. The magnetization of iron and steel in weak fields was investigated, and with annealed and hard cast steel and with cast iron a straight line relation was found, while for hard and soft wrought iron the relation was not so simple. The electric conductivity of solutions was also examined, and the results show that the electric current is very suitable for scientific research with solutions and in chemistry, being in some respects superior to other methods in analyses.

UNIVERSITY AND EDUCATIONAL NEWS.

UNIVERSITY Day at the University of Pennsylvania, annually celebrated on Washington's Birthday, was this year the occasion of an address by President McKinley, who reviewed the services of Washington to the nation and to education and the importance of education to national life.

COMMEMORATION Day was also celebrated at Johns Hopkins University on Washington's Birthday. In the course of an address President Gilman said that, in accordance with the wishes of many of its friends and supporters, taxpayers and citizens of Maryland, the Johns Hopkins University has decided to present a statement of its financial condition to the Legislature of Maryland to ask for State aid. Through the failure of the Baltimore and Ohio

Railroad, as is well known, the University has lost an income of $150,000 from funds invested in the railroad by the late Johns Hopkins. The sum of $250,000, $50,000 per annum, has been subscribed by friends of the University, but in spite of this the University is seriously hampered by the loss of its former income.

THE new building erected for the Ohio University at Athens has just been completed. It is a T-shaped structure, having a front of 156 feet and a depth of 131 feet. It contains an auditorium capable of seating about nine hundred persons; a gymnasium having a floor space of three thousand feet; a physical and electrical laboratory, a number of recitation rooms, offices, music-rooms, etc. The Ohio University is the oldest institution for higher education in the Northwest Territory, having been chartered in 1804. The main building, which is still in use, was erected in 1817. Ohio has now four universities, all of which have been provided by the Legislature with a permanent income.

COLBY University will begin at once the erection of a chemical laboratory to cost not less than $30,000.

THE Alumnæ Association of Bryn Mawr College has presented the College with $8,000 for a scholarship as a memorial to the first President of the College, the late Dr. James E. Rhodes.

DR. CHARLES DE GARMO, President of Swarthmore College, has been elected professor of the science and art of education at Cornell University. At the same University Professor H. W. Hibberd, of the University of Minnesota, has been elected assistant professor of railway engineering.

DR. H. EBERT, of Kiel, has been appointed professor of physics at Munich.

M. JENVRESSE has been appointed professor of industrial and agricultual chemistry in Besançon, M. Dubois associate professor of chemistry at Claremont, and M. Matignon lecturer in mineralogical chemistry at Lille, filling temporarily the chair vacant by the death of M. Joli.

AN anonymous donor has offered £10,000 for the extension of the buildings of Aberdeen University on condition that the government grant £20,000 for this purpose. It is expected that the town will also assist.

DISCUSSION AND CORRESPONDENCE.

BREVITY IN CITATIONS.

TO THE EDITOR OF SCIENCE: In one small matter, at least, the bibliographical reform which is making great strides has as yet failed to produce any improvement over past conditions. And it is not in the spirit of criticism, but in the hope that needed relief may be afforded, that public attention is hereby called to this item.

All authors who devote that care to bibliographical citations which is desirable give an exact statement of the volume, pages, plates, etc., for each paper or work to which reference is made; and one might well wish that this were at times more general, especially where an entire half day has been devoted to the search of a loosely quoted passage which happens to be essential to the point in mind. No one would desire to limit or in any way discourage this practice, but there is one feature that seems to be a waste of space, time and energy—namely, the endless repetition of the words volume, number, part and page, or their equivalent in some other language. Even in the usual abbreviated form in which such words appear they mean, in the aggregate, not a little space and time to both author and publisher. I am aware that individuals have endeavored more or less consistently and sometimes successfully to abandon them, but despite this the words continue to be generally used. Is this not largely because there has been no agreement as to the form a citation shall take, and, consequently, some uncertainty as to the interpretation of the reference, which causes the careful student to hesitate in introducing a system that may trouble or mislead his readers.

Our botanical confrères adopted in 1895, at the Madison Botanical Congress, a set of rules for citation which appear in every way admirable. They are clear, concise and seemingly complete, and the saving in their use is evident from the examples given. I have no means of knowing how generally they have been adopted by botanists, even in this country, and it is, of course, questionable whether they would be in-

troduced by the investigators and writers of other countries for evident reasons. To be permanently valuable to science, and to effect for the world a real saving, such measures must needs be international in character.

The admirable cards of the International Bibliographical Bureau at Zürich still continue to add in abbreviated form the words referred to above. Some such rules as those adopted by the Botanical Congress could be promulgated by the Bureau, with the hope that they would be generally understood and in time generally adopted. Am I wrong in believing such a movement for simplicity and uniformity in citation (1) desirable, (2) possible, (3) most likely to succeed under these circumstances?

Henry B. Ward.

University of Nebraska.

SCIENTIFIC LITERATURE.

Pflanzenphysiologie, ein Handbuch der Lehre vom Stoffwechsel und Kraftwechsel in der Pflanze. Zweite völlig umgearbeitete Auflage. Dr. W. Pfeffer. Leipzig, Wilhelm Engelmann. 1897. Erster Band. Stoffwechsel.

It is safe to say that no handbook of plant physiology has yet appeared which, for comprehensiveness and breadth of treatment, keen criticism of conflicting researches, truthfulness of perspective, accuracy of detail and logical delimitation of the subject and its branches can be compared to Pfeffer's encyclopedic work, which now comes to the second edition. Perhaps no greater tribute to the merit of this great work and the master mind that planned it can be given than the fact that, after sixteen years of the most productive research in the history of botany, the author does not find it necessary to alter his method of treatment, although the establishment and development of many important principles have taken place in this period. The first volume is devoted to chemical physiology, and the second, now in preparation, to physical physiology, or phytodynamics. The treatment is strictly inductive, with no lapses into speculation, or leanings toward vitalism, and, moreover, all the subjects included are fairly physiological, but scant discussion being given to ecological adaptations, though the method of variation is necessarily pointed out. The ten chapters of the first volume, now at hand, discuss the province of physiology, the nature of irritability, variation and hereditary, morphological-physiological considerations, swelling and molecular structure, mechanism of interchange of matter, mechanism of interchange of gases, the movements of water in the plant, nutrition, organization and energy of metabolism, respiration, fermentation and translocation. The contents of the separate chapters afford a ready appreciation of the development of the subject from 1881 to 1897, a record of progress in which Dr. Pfeffer and his students have taken an important part. The keen critical faculty of the author has enabled him to express clearly the condition of important questions yet in controversy, and, throughout the entire volume, generous and just estimate is made of the work of physiologists outside of Germany.

The author does not accept the term 'Energid,' of Sachs, as the physiological unit, and finds that 'cell' or 'protoplast' is still useful in that capacity. Barymorphose, photomorphose, etc., by the same author, are shown to be inapplicable to the influence of external agencies upon form and development. The foam structure of protoplasm, as described by Butschli, finds place in the discussion of the composition of protoplasm. Cilia and vacuoles are described as organs which may arise *de novo*, while no decision is reached as to the much harassed centrosome question.

Full place is given to recent researches showing the invariable connection between nuclei and the formation of wall membranes, and the facilities afforded for the translocation of plastic material, as well as of the protoplasm itself by means of the interprotoplastic threads, is pointed out. A new lease of life is given this theory by the adduction of evidence from recent researches that such substances as the oils are known to pass membranes in a finely divided condition.

The micellar theory of Nageli is used as a basis of the discussion of molecular structure, although the enlargement of the section devoted to this subject is due to collection of detail rather than development of principles involved.

The mechanics of absorption, excretion and secretion, diosmotic and osmotic properties of the cell with regard to fluids and gases have received such numerous and important additions that it would be possible to point them out only by recounting the summaries of the sections, which space does not permit, but much of the author's own work is briefly summarized here for the first time.

This is the first general text issued since the researches of Boehm, Askenasy, Strasburger, Schwendener, Dixon and Joly upon the ascent of sap were published, and the Jaminian chain, the intermittent activity of living cells, the lifting power of transpiration and the tensile strength of water are alike shown to be incompetent to account for the facts. Professor Pfeffer believes that whatever the impelling force may be, and the participation of living cells is not barred, the path of the current lies through the tracheal lumina and pits.

Transpiration is recognized as a necessary means for the distribution of the mineral elements in the plant, as a facilitation of gas diffusion, as a regulator of temperature, and the surmise is hazarded that it also may exercise a general tonic effect necessary for the maturity and welfare of the plant. A clear presentation of the relation of stomatal, cuticular and lenticular transpiration is made, as well as of the factors influencing these processes and the principal adaptations.

Bleeding and the phenomena of root-pressure are held to be due to the active secretory agency of living cells, in the root and stem, though plasmolytic agencies, as in nectaries may sometimes play a part in the process; and no essential difference from 'guttation' is exhibited. The water-pores and hyathodes of plants in moist localities may provide an outlet for water to maintain the upward stream, impossible by transpiration.

The chapter on nutrition contains 168 pages, in which all of the more important literature of the subject finds place, and it is impossible in the limits of this review to cite even a majority of the new and modified points of view given. In the consideration of the general metabolic activity of the organism all material is divided into three groups, viz.: constructive substances in the permanent structure of the organism, plastic substances capable of participation in the metabolic processes, and aplastic substances incapable of being used further in the nutrition of the organism. The last group naturally overlaps the first named.

Assimilation is used in the broadest sense to denote all physiological processes, or progressive chemical metamorphoses by which plastic or trophic substances are built up. According to the source of energy specific processes are designated as 'Photosynthese,' 'Chemosynthese,' 'Electrosynthese,' etc.

By photosynthesis is meant the formation of plastic material from carbon compounds, CO_2, (possibly $COCL_2$, COS, $CO\ (NH_2)_2$,) and water by the agency of the chlorophyll apparatus and sunlight, a sense in which it has been used by the reviewer since 1894, though not in agreement with the proceedings of the Madison Botanical Congress. (See editorial review, Botanical Gazette, Vol. 19, p. 341. 1894.)

Professor Pfeffer points out that the relation of chorophyll to the ground substance of the chloroplast is unknown, that the optical extinction of portions of the spectrum may or may not be coincident with photosynthetic activity, and that the intermediate steps in the formation of carbohydrates in this manner are unknown. The recent results of investigation upon the independent action of chloroplasts are detailed.

The nitrobacteria are instanced as the only organisms having the power of formation of carbohydrates from CO_2 by synthetic methods and by means of chemical energy.

The author distinguishes between saprophytic and symbiotic nutrition, using the former term only in connection with plants which take up organic food unaided. According to this classification the only seed-forming plants truly and entirely saprophytic are confined to a single genus. With regard to the general relation to organic food, plants are allotropic, mixotropic or autotropic. The results bearing upon the acquisition of nitrogen are brought together in orderly array, but our information on this phase of nutrition is at best very incomplete.

The discussion of the metabolic changes in the organism is enriched by the addition of an enormous mass of detail, yet it is to be said that

the diagram of chemical activities is largely suppositious, and that substances may be located here and there, with no indication decisive of synthetic or analytic origin.

The author includes many energy liberating processes under respiration, whether attended by excretion of CO_2 or not, and emphasizes the fact that it is only a link in the chain of metabolic metamorphoses. It is, therefore, not always possible to determine the subjects or products of respiration.

A comparison of the editions of 1881 and 1897 reveals the fact that Professor Pfeffer no longer deals with the organism as a purely chemical and physical machine, but regards it from a physiological point of view. Nowhere is this more vividly apparent than in a paragraph dealing with translocation, which is freely translatable as follows: "In general, translocation is regulated by the vital activity. By this the functioning apparatus is controlled, and apparently the organism is capable of modifying the permeability of the protoplast temporarily in many ways. Indeed, it is not improbable that the living protoplast, by its own activity, not only conducts solid particles and oil drops, but also under some circumstances dissolved substances for which it is not diosmotic. Furthermore, diosmose is not dependent entirely upon the size of the dissolved molecules, since many colloids may be easily taken up and given off."

The terse, vigorous, concise style and generally high literary quality make this volume a classic in botanical literature. The author has rendered an inestimable service to biological science by his masterly criticism and arrangement of the accumulated results of research upon the physiology of the vegetal organism, and his vivid clear-cut delineation of the problems awaiting investigation will give a new impetus to research in this and related lines.

Arrangements have already been made for the translation of the book into French and English. The English edition will be prepared under the direction of Dr. Ewart, whose intimate acquaintance with the author and important researches in the Leipsic Institute make him especially well fitted for the task.

D. T. MACDOUGAL.

Trail and Camp Fire, the Book of the Boone and Crockett Club. Editors: GEORGE BIRD GRINNELL and THEODORE ROOSEVELT. New York, Forest and Stream Publishing Co. December, 1897. 8vo. Pp. 353. Illustrated. Price, $2.50.

Beginning in 1893, the Boone and Crockett Club has published on alternate years a volume made up of articles on big game and big game hunting, with tales of exploration in little known lands. While written primarily for the sportsman, these books contain much of interest to the naturalist; and to the student of the larger mammals they are indispensable. The new volume, 'Trail and Camp Fire,' contains the following: 'The Labrador Peninsula,' A. P. Low; 'Cherry,' Lewis S. Thompson; 'An African Shooting Trip,' Wm. Lord Smith; 'Sintamaskin,' C. Grant LaFarge; 'Wolves and Wolf Nature,' George Bird Grinnell; 'On the Little Missouri,' Theodore Roosevelt; 'Bear Traits,' George Bird Grinnell, J. C. Merrill, Theodore Roosevelt and Henry L. Stimson; 'The Adirondack Deer Law,' Wm. Cary Sanger; 'A Newfoundland Caribou Hunt,' Clay Arthur Pierce; 'Origin of the New York Zoological Society,' Madison Grant. To these is added a chapter on 'Books on Big Game'—one of the most entertaining and useful in the volume—treating of the more important works on big game hunting in Africa, India and America.

Trustworthy information relating to the interior of the Labrador peninsula is so scarce that Mr. Low's article will be widely welcomed and will reach a different audience from his much more elaborate official report (Annual Report Geological Survey of Canada, N. S., Vol. VIII., pp. 1–387, Ottawa, 1897). It is a pity that his important notes on big game are marred by antiquated and inaccurate nomenclature.

Without attempting to point out the many good things in the book, it may be said that the chapters on Wolves and Bears are intensely interesting, and that Mr. Wm. Lord Smith's account of his 'African Shooting Trip,' in company with Dr. A. Donaldson Smith, is an important addition to the literature of the rapidly diminishing game of the 'Dark Continent.'

The editors' statement that "coyotes try to

catch and eat badgers" seems to need some sort of qualification. The reviewer and at least one of his associates have on several occasions seen coyotes and badgers cross each other's tracks, without the slightest show of fear or aggressiveness on either side; and persons familiar with the strength, ferocity and resisting powers of the badger can hardly imagine a coyote rash enough to meddle with one. Of course, a hungry coyote might tackle a young or enfeebled badger, but in the case of adults in ordinary health and spirits it is hard to believe that a coyote would ever invite such a terrible contest.

'Trail and Camp Fire' is a storehouse of information for the sportsman-naturalist and a worthy companion of 'American Big Game Hunting' and 'Hunting in Many Lands,' its predecessors in the Boone and Crockett series.

C. H. M.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 480th meeting was held at the Cosmos Club on Saturday evening, February 19th, at 8 p. m. The first paper was by Mr. H. A. Hazen on 'The Origin and Value of Weather Folk-lore.' In substance Mr. Hazen said: "A weather saying or sign to be of value should be based on a sufficient number of coincidences between the sign and the supposed resulting weather to make it a law." It was shown that four-fifths at least of the current weather signs and proverbs could not be regarded laws. "The earliest of these signs, some think, is in Job [Canst thou bind the sweet influences of the Pleiades], but this refers only to the fact that, before the calendar month and year were established, the rising and setting of the constellations were taken by the ancients to mark the seasons and the times of sowing and harvesting. There is no thought that the Pleiades have any direct influence upon terrestrial conditions. Hesiod (850 B. C.) gives the cuckoo (rain crow) sign of rain, and it is a little remarkable that this early sign has come down through the ages as the best animal sign of rain."

The author spoke of pseudo weather lore; signs from the moon (universal in civilized nations); from the planets, which may be brought down to the planetarians of the present day; from eclipses, clouds, halos; from animals, birds, etc.

The second paper was by Mr. W. H. Dall, who spoke on the condition of Tertiary Paleontology in the United States. The speaker restricted himself to a consideration of the fossil invertebrates of marine origin. He briefly sketched the history of this branch of American science, from its beginnings with Say, Morton, Lea and Conrad, to the present time, showing how, after the energy of the earlier Philadelphia school had spent itself, a period of comparative inaction set in, which had now given way to renewed activity, which is gradually placing this branch of the science on a modern basis. This awakened interest is largely due to the initiative of the Wagner Free Institute of Science in Philadelphia and the extension of the work of the United States Geological Survey to the coastal plain and phosphate regions of the Southern States.

E. D. PRESTON,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO, MEETINGS OF DECEMBER AND JANUARY.

Maturation and Fertilization of the Egg of Arenicola Marina. In the earliest stage in which centrosomes have been seen, there are two, at some distance from each other in the cytoplasm, each surrounded by a small, deeply staining area, and few, very delicate radiations. The rays elongate, a large spindle is formed, and the chromosomes, now lying free in the cytoplasm, arrange themselves upon it. In approaching its definitive position at the pheriphery of the egg, this first polar spindle contracts to about one-half its original length. The centrosomes at each pole divide as the separation of the chromosomes begins. The two centrosomes at the inner pole form the poles of the second polar spindle. They move apart, showing a central spindle, new asters appear, and the spindle assumes the position occupied by the first polar spindle.

After the formation of the second polar body the female pronucleus is formed, and the 'female' centrosome and aster disappear. The sperm apparently enters at any point, but cannot be

distinguished from yolk granules at first, as, for some time, no 'male' aster appears. Later, however, the sperm-head enlarges and an aster and centrosome appear, the centrosome divides and two asters are formed connected by a spindle. All of these disappear, however, at the same time as the female aster and centrosome.

When the two pronuclei come into contact no centrosomes or asters are visible in the egg. The two pronuclei as a whole form the center of a large radiation extending nearly to the periphery of the egg. A little later a very minute centrosome and aster appear on each side of the pronuclei in the copulation plane. Both centrosomes and asters increase in size, one being larger than the other (the first cleavage is unequal), fibers extend past the pronuclei from one centrosome to the other and the first cleavage spindle is formed. The pronuclei elongate and lose their membranes without preceding fusion. As the astral rays elongate, the radiation which surrounded the pronuclei disappears and the cytoplasm rearranges itself as the rays of an aster centering about a centrosome.

C. M. CHILD.

Notes on the Peripheral Nervous System of Molgula Manhattensis. The intra-vitam method of methylene blue staining was used. Sensory cells occupying a lateral position in the endostyle were found. These cells are characterized by a distal knob or spike and one or more proximally placed enlargements, one of which contains the nucleus. Some cells showed protoplasmic (?) branchings. No supporting cells were seen. Nerve fibrils, after leaving the epithelium, turn sharply at right angles to run longitudinally as separate fibrils or in loose bundles. They probably reach the (brain) ganglion by the circumbuccal nerves.

The endings in the branchial basket are knob- or disk-like. Nerve fibrils may end on cells in the walls of the branchial bars or freely. Fibrils may lie in the supporting tissue or be applied to the base of the epithelium, and, singly or in bundles, anastomose to form a true plexus. Ganglion cells are found. Fibrils end on the basal part of mucus or ciliated cells in club or disk-shaped endings. Other fibers touch the base of a cell with a knob-like varicosity and continue their course, touching neighboring cells in like manner before finally ending.

A sub-epithelial plexus was found in other parts of the body. Nerve endings were found in the muscles and ciliated funnel. The sensory nature of the tentacles and papillæ of the peribranchial sac was not demonstrated.

G. W. HUNTER, JR.

DURING the two months the following reviews and papers were also given: 'Recent Literature on the Embryology of Insects' (Uzel and Heymons), Dr. W. M. Wheeler; 'The Lithodidæ, a Family of Asymmetrical Crabs,' S. J. Holmes; 'Theories of Animal Phosphorescence,' Dr. Watasé; 'Some of the Functions and Features of a Biological Station,' Dr. Whitman; 'Recent Literature on Regeneration' (Joest), W. H. Packard; 'A Review of Some Recent Work on Spermatogenesis' (Bardeleben), M. F. Guyer; 'Experimental Work on the Cilnophore Egg' (Fischel), Dr. Child; 'The Pronephros in Teleosts' (Felix), Miss E. R. Gregory.

TORREY BOTANICAL CLUB.

AT the annual meeting, January 10, 1898, cash balances to the favor of the Club were reported by the Treasurer and the Editor.

The Recording Secretary, Professor Burgess, reported an average attendance of 35 at the 15 meetings held during the year, one death, a present active membership of 213, corresponding membership of 153, honorary membership of 4, total 370. Thirty scientific papers have been presented.

The Editor, Dr. Britton, reported the regular monthly publication of the *Bulletin*, including 592 pages, 33 plates and 1 portrait; and the publication of Vol. VI., No. 2, of the *Memoirs*, containing 80 pages, issued July 30, 1897.

Dr. Small reported for the Field Committee that field meetings were arranged for every Saturday from April 24th to October 30th, and also on election day—29 excursions in all. These were usually half-day excursions, with 4 of the whole day and 4 of two days each. They have extended into the neighboring mainland of New York, into Long Island, Staten Island, New Jersey and Pennsylvania. The average attendance upon the excursions was about 16, and the average number of plants specially recorded 48.

Dr. Rusby, in behalf of the Committee on Program, announced arrangements in progress relative to presentation of several interesting topics before the Club by botanists from other cities.

The fourth order of business was the annual election, resulting in the main in the re-election of the previous officers. The Treasurer, Mr. Ogden, and the Editor, Dr. Britton, on account of pressing present obligations, declined re-election. Their services, rendered for a long series of years, elicited remarks of hearty appreciation.

The officers for 1898 include the following: President, Addison Brown; Vice-Presidents, T. H. Allen, H. H. Rusby; Treasurer, Maturin L. Delafield, Jr.; Recording Secretary, Edward S. Burgess; Corresponding Secretary, John K. Small; Editor, Lucien M. Underwood.

Discussion on the development of the tomato and strawberry followed.

Professor Lloyd spoke of the work of Professor L. H. Bailey upon the origin of the tomato, and exhibited illustrative specimens loaned by Professor Bailey, with others to indicate that *Fragaria Chilensis* is the source of the cultivated strawberry. He also exhibited the original specimen of the strawberry known as Hovey's Seedling.

Dr. Rusby spoke of his experience with the *Fragaria Chilensis* as cultivated in the Bolivian Andes, where, at 10,000 feet altitude, its growth is luxuriant, standing up nearly to the knees. Its fruit is large and juicy, does not keep well, and is without flavor or fragrance. It bears continuously, and he ate from it every month of the year but two. Its identity with the coast form was questioned by Dr. Britton.

Dr. Rusby also exhibited a sample of *Fragaria Mexicana*, by some identified with *F. Chilensis*, and by others with *F. vesca*, but which keeps well and is high flavored.

EDWARD S. BURGESS,
Secretary.

SCIENTIFIC JOURNALS.

The Journal of Geology for January–February, 1898, contains papers on the following subjects: 'An Hypothesis to Account for the Movement in the Crust of the Earth,' J. W. POWELL. After a preliminary introductory statement, the general disturbances of an organic and epeirogenic character are explained by the principle that under sufficient loading, rocks flow; but that the modulus of compression varies for different rocks, and for the same rock as its critical point is approximated. As this point is reached freedom of molecular movement may even become so marked as to cause recrystallization. All these changes tend to produce upheaval and subsidence. 'Estimates and Causes of Crustal Shortening,' C. R. VAN HISE. The author considers the crustal shortening to have probably been much less than is generally assumed and, after a discussion of its various effects and concomitant phenomena in rocks, takes up the following conceivable causes: secular cooling, vulcanism, cementation, change of pressure, change in physical conditions, loss of water and gas. 'Note on the pressure within the earth,' by CHARLES S. SLICHTER. The paper discusses "the magnitude of the pressures within the earth-spheroid, especially as influenced by the changes that have been brought about in the ellipticity of the earth's figure by its changing rotation period." 'The geological *versus* the petrographical classification of igneous rocks,' by WHITMAN CROSS. The paper distinguishes the petrological from the petrographical point of view in rock classification and in a very temperate and excellent manner advocates the latter for systematic classification, the former for theoretical discussion. No actual scheme is, however, advanced. The paper was read at the Montreal meeting of the Geological Society of America and has been previously abstracted in these columns (p. 83). 'On Rock Classification,' by J. P. IDDINGS. With several very suggestive and comprehensive diagrams the author discusses the chemical relations of the igneous rocks. The paper was read at the Montreal meeting of the Geological Society of America and has been previously reviewed in these columns (p. 83).

American Chemical Journal, February.—'On the Action of Acetic Anhydride on Phenylpropiolic Acid': By ARTHUR MICHAEL and J. E. BUCHER. The authors find that in

this reaction polymerization takes place with the formation of a naphthalene compound. 'The Relation of the Taste of Acids to their Degree of Dissociation': By T. W. RICHARDS. The relative strength and extent of dissociation of dilute acid solutions can be determined approximately by the sense of taste. 'Note on Fehling's Solution': By J. B. TINGLE. The ordinary solution containing tartaric acid is reduced even at the ordinary temperature if it has been partly neutralized with the free mineral acids and also decomposes spontaneously if allowed to stand. It is, therefore, necessary to use a freshly prepared solution. If, however, glycerine and ammonium hydroxide are used, instead of the tartaric acid salt, a solution is obtained which is perfectly stable. 'Action of the Anhydride of Orthosulphobenzoic Acid on Dimethyl- and on Diethylanaline': By M. D. SOHON. Formation of the corresponding aniline sulphonphthaleins. 'The Molecular Weight of Lactimide': By G. M. RICHARDSON and M. ADAMS. The evidence speaks in favor of the double formula. 'The Action of Sodium Ethylate upon a, β—Dibromhydrocinnamic Ester, Citradibrompyrotartaric Ester, and a, β—Dioromprapionic Ester': By V. L. LEIGHTON. 'On some Bromine Derivatives of 2, 3,—Dimethylbutane': By H. L. WHEELER. 'Phosphatic Chert': By J. H. KASTLE, J. C. W. FRAZER and GEO. SULLIVAN. Analyses of phosphatic limestone. 'On the Effect of Light on the Combination of Hydrogen and Bromine at High Temperatures': By J. H. KASTLE and W. A. BEATTY. Light causes the combination of hydrogen and bromine at 196°.

J. ELLIOTT GILPIN.

The *Zeitschrift für den physikalischen und chemischen Unterricht* (Berlin, Julius Springer) deserves to be better known than it is by the teachers in our secondary schools. The ten volumes now completed are full of valuable matter bearing upon the teaching of physcial sciences. In the first, January, number of the eleventh volume, the editor, Dr. Poske, reviews the history of the journal, reaffirms strongly his frequently expressed opinion of the humanistic character of all proper general physical instruction, and urges teachers to make less of theory and hypothesis and more of experiment and experience. Then follow some notes by that wonderfully bright and prolific writer, Professor Mach, of Vienna, one of the associate editors, upon the 'Historical Development of Optics.' Dr. Strecker, of Berlin, writes upon theory and practice in the construction of rheostats for small physical laboratories. Then follows an article upon the nature of visible water-vapor and its experimental production before a class. Then we have Professor van't Hoff's paper of last summer before the Scientific Congress in Berlin on 'Stereo-chemistry.' Descriptions of new apparatus and experiments, historical notes, courses and methods of instruction, technics and mechanical praxis, new books, reports of scientific societies, and astronomy for the year, with maps, complete the volume.

E. A. STRONG.

YPSILANTI, MICH.

NEW BOOKS.

Leçons sur l'intégration des équations aux dérivées partielles du second ordre a deux variables indépendantes. E. GOURSAT. Paris, A. Hermann. 1898. Vol. II. Pp. 344.

Peneroplis, eine Studie zur biologischen Morphologie und zur Speciesfrage. FRIEDRICH DREYER. Leipzig, Wilhelm Engelmann, 1898. Pp. vi+119+5 plates. 10 Marks.

Pasteur. PERCY FRANKLAND and MRS. PERCY FRANKLAND. New York, The Macmillan Co. Pp. vi+224. $1.25.

Angewandte Elektrochemie. FRANZ PETERS. Wien, Pest, Leipzig. A. Hartleben's Verlag. Vol. 2. 1st part, pp. xi+248; 2nd part, pp. xii+215.

The Arrangement of Atoms in Space. J. H. VAN'T HOFF. Second revised and enlarged edition; translated and edited by Arnold Eilvart. London, New York and Bombay, Longmans, Green & Co. 1898. Pp. vi+211.

Spectrum Analysis. JOHN LANDOWER. Authorized English Edition by J. BISHOP TINGLE. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. 1898. Pp. x+239.

Outlines of Descriptive Psychology. GEORGE TRUMBULL LADD. New York, Charles Scribner's Sons. 1898. Pp. xi+428. $1.50.

SCIENCE

Friday, March 11, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE DEBT OF THE WORLD TO PURE SCIENCE.**

The fundamental importance of abstruse research receives too little consideration in our time. The practical side of life is all-absorbent; the results of research are utilized promptly and full recognition is awarded to the one who utilizes while the investigator is ignored. The student himself is liable to be regarded as a relic of medieval times and his unconcern respecting ordinary matters is serviceable to the dramatist and newspaper witlet in their times of need.

Yet every thoughtful man, far away as his calling may be from scientific investigation, hesitates to accept such judgment as accurate. Not a few, engrossed in the strife of the market-place, are convinced that, even from the selfish standpoint of mere enjoyment, less gain is found in amassing fortunes or in acquiring power over one's fellows than in the effort to solve Nature's problems. Men scoff at philosophical dreamers, but the scoffing is not according to knowledge. The exigencies of subjective philosphy brought about the objective philosophy. Error has led to the right. Alchemy prepared the way for Chemistry; Astrology for Astronomy; Cosmogony for Geology. The birth of in-

* Presidential address delivered at the annual meeting of the New York Academy of Sciences, February 28, 1898.

ductive science was due to the necessities of deductive science, and the greatest development of the former has come from the trial of hypotheses belonging in the borderland between science and philosophy.

My effort this evening is to show that discoveries, which have proved all-important in secondary results, did not burst forth full-grown; that in each case they were, so to say, the crown of a structure reared painfully and noiselessly by men indifferent to this world's affairs, caring little for fame and even less for wealth. Facts were gathered, principles were discovered, each falling into its own place until at last the brilliant crown shone out and the world thought it saw a miracle.

This done, I shall endeavor to draw a moral, which it is hoped will be found worthy of consideration.

The heavenly bodies were objects of adoration from the earliest antiquity; they were guides to caravans on the desert as well as to mariners far from land; they marked the beginning of seasons or, as in Egypt, the limits of vast periods embracing many hundreds of years. Maps were made thousands of years ago showing their positions; the path of the sun was determined rudely; the influence of the sun and moon upon the earth was recognized in some degree and their influence upon man was inferred. Beyond these matters, man, with unaided vision and with knowledge of only elementary mathematics, could not go.

Mathematical investigations by Arabian students prepared the means by which, after Europe's revival of learning, one, without wealth, gave a new life to astronomy. Copernicus, early trained in mathematics, during the last thirty years of his life spent the hours, stolen from his work as a clerk and charity physician, in mathematical and astronomical studies, which led him to reject the complex Ptolemaic system and to accept, in modified form, that bearing the name of Pythagoras. Tycho Brahe followed. A mere star-gazer at first, he became an earnest student, improved the instruments employed, and finally secured recognition from his sovereign. For twenty-five years he sought facts, disregarding none, but seldom recognizing economic importance in any. His associate, Kepler, profiting by his training under Brahe, carried the work far beyond that of his predecessors—and this in spite of disease, domestic sorrows and only too frequent experience of abject poverty. He divested the Copernican hypothesis of many crudities and discovered the laws which have been utilized by astronomers in all phases of their work. He ascertained the causes of the tides, with the aid of the newly invented telescope made studies of eclipses and occultations and just missed discovering the law of gravitation. He laid the foundation for practical application of astronomy to every-day life.

In the 18th century astronomy was recognized by governments as no longer of merely curious interest and its students received abundant aid. The improvement of the telescope, the discovery of the law of gravitation and the invention of logarithms had made possible the notable advances marking the close of the 17th century. The increasing requirements of accuracy led to exactness in the manufacture of instruments, to calculation and recalculation of tables, to long expeditions for testing methods as well as conclusions, until finally the suggestion of Copernicus, the physician, and of Kepler, the ill-fed invalid, became fact, and astronomical results were utilized to the advantage of mankind. The voyager on the ocean and the agriculturist on land alike reap benefit from the accumulated observations of three centuries, though they know nothing of the principles or of the laborers by whom the principles were discovered. The regulation of chronom-

eters as well as the fixing of boundary lines between great nations is determined by methods due to slow accumulation of facts, slower development in analysis and calculation and even slower improvement in instruments.

Galvani's observations that frogs' legs twitch when near a friction machine in operation led him to test the effect of atmospheric electricity upon them. The instant action brought about the discovery that it was due not to atmospheric influence, but to a current produced by contact of a copper hook with an iron rail. Volta pursued the investigation and constructed the pile which bears his name. With this, modified, Davy, in 1807, decomposed potash and soda, thereby isolating potassium and sodium. This experiment, repeated successfully by other chemists, was the precursor of many independent investigations, which directed to many lines of research, each increasing in interest as it was followed.

Volta's crown of cups expanded into the clumsy trough batteries which were displaced finally in 1836 by Daniel's constant battery, using two fluids, one of which was cupric sulphate. De la Rue observed that, as the sulphate was reduced, the copper was deposited on the surface of the outer vessel and copied accurately all markings on that surface. Within two or three years Jacobi and Spencer made the practical application of this observation by reproducing engravings and medals. Thus was born the science of electro-metallurgy. At first mere curiosities were made, then electro-plating in a wider way, the electrotype, the utilization of copper to protect more easily destructible metals, the preparation of articles for ornament and utility by covering baser metals with copper or silver or gold, while now the development of electro-generators has led to wide applications in the reduction of metals and to the saving of materials which otherwise would go to waste.

Oersted, in 1819–1820, puzzling over the possible relations of voltaic electricity to magnetism, noticed that a conductor carrying an electrical current becomes itself a magnet and deflects the needle. Sturgeon, working along the same lines, found that soft iron enclosed in a coil, through which a current passes, becomes magnetic, but loses the power when the current ceases. This opened the way for our own Henry's all-important discovery of the reciprocating electro-magnets and the vibrating armature—the essential parts of the magnetic telegraph. Henry actually constructed a telegraph in 1832, winding the wires around his class-room in Albany and using a bell to record the making and breaking signals. Here, as he fully recognized, was everything but a simple device for receiving signals.

Several years later Professor Morse, dreaming night and day of the telegraph, was experimenting with Moll's electro-magnet and finding only discouragement. His colleague, Professor Gale, advised him to discard the even then antiquated apparatus and to utilize the results given in Henry's discussion. At once the condition was changed, and soon the ingenious recording instrument bearing Morse's name was constructed. Henry's scientific discoveries were transmuted by the inventor's ingenuity into substantial glory for Morse and proved a source of inconceivable advantage to the whole civilized world. Steinhal's discovery that the earth can be utilized for the return current completed the series of fundamental discoveries, and since that time everything has been elaboration.

Oersted's discovery respecting the influence of an electric current, closely followed by that of Arago in the same direction, opened the way for Faraday's complete discovery of induction, which underlies the construction of the dynamo. This ascertained, the province of the inventor was well defined—to conjure some mechanical

appliance whereby the principle might be utilized. But here, as elsewhere, the work of discovery and that of invention went on almost *pari passu;* the results of each increased those of the other. The distance from the Clark and Page machines of the middle thirties, with their cumbrous horseshoe magnets and disproportionate expenditure of power, to the Siemens machine of the fifties was long; but it was no leap. In like manner, slow steps marked progress thence to the Gramme machine, in which one finds the outgrowth of many years of labor by many men, both investigators and inventors. In 1870, forty years after Faraday's announcement of the basal principle, the stage was reached whence progress could be rapid. Since that time the dynamo has been brought into such stage of efficiency that the electro-motor seems likely to displace not merely the steam engine, but also other agencies in direct application of force. The horse is passing away and the trolley road runs along the country highway; the longer railways are considering the wisdom of changing their power; cities are lighted brilliantly where formerly the gloom invited highwaymen to ply their trade; and even the kitchen is invaded by new methods of heating.

Long ago it was known that, if the refining of pig iron be stopped just before the tendency to solidify became pronounced, the wrought iron is more durable than that obtained in the completed process. Thus imperfectly refined metal was made frequently, though unintentionally and ignorantly. A short railroad in southwestern Pennsylvania was laid in the middle sixties with iron rails of light weight. A rail's life in those days rarely exceeded five years; yet some of those light rails were in excellent condition almost fifteen years afterwards, though they had carried a heavy coke traffic for several years. But this process was uncertain, and the best puddlers could never tell when to stop the process in order to obtain the desired grade.

When a modification of this refining process was attempted on a grand scale almost contemporaneously by Martien in this country and Bessemer in England the same uncertainty of product was encountered; sometimes the process was checked too soon, at others pushed too far. Here the inventor came to a halt. He could use only what was known and endeavor to improve methods of application. Under such conditions the Bessemer process was apparently a hopeless failure. Another, however, utilized the hitherto ignored work of the closet investigator. The influence of manganese in counteracting the effects of certain injurious substances and its relation to carbon when present in pig iron were understood as matters of scientific interest. Mushet recognized the bearing of these facts and used them in changing the process. His method proved successful; but, with thorough scientific forgetfulness of the main chance, he neglected to pay some petty fees at the Patent Office, and so reaped neither profit nor popular glory for his work.

The Mushet process having proved the possibility of immediate and certain conversion, the genius of the inventor found full scope. The change in form and size of the converter, the removable base, the use of trunnions and other details, largely due to the American, Holley, so increased the output and reduced the cost that Bessemer steel soon displaced iron and the world passed from the age of iron into the age of steel.

Architectural methods have been revolutionized. Buildings ten stories high are commonplace; those of twenty no longer excite comment, and one of thirty arouses no more than a passing pleasantry respecting possibilities at the top. Such buildings were almost impossible a score of years ago,

and the weight made the cost prohibitive. The increased use of steel in construction seems likely to preserve our forests from disappearance.

In other directions the gain through this process has been more important. The costly, short-lived iron rail has disappeared and the durable steel rail has taken its place. Under the moderate conditions of twenty-five years ago, iron rails rarely lasted for more than five years; in addition, the metal was soft, the limit of load was reached quickly, and freight rates, though high, were none too profitable.

But all changed with the advent of steel rails as made by the American process. Application of abstruse laws, discovered by men unknown to popular fame, enabled inventors to improve methods and to cheapen manufacture until the first cost of steel rails was less than that of iron. The durability of the new rails and their resistance to load justified increased expenditure in other directions to secure permanently good condition of the roadbed. Just here our fellow member, Mr. P. H. Dudley, made his contribution, whose importance can hardly be overestimated. With his ingenious recording apparatus, it is easy to discover defects in the roadway and to ascertain their nature, thus making it possible to devise means for their correction and for preventing their recurrence. The information obtained by use of this apparatus has led him to change the shape and weight of rails, to modify the type of joints and the methods of ballasting, so that now a roadbed should remain in good condition and even improve during years of hard use.

But the advantages have not inured wholly to the railroad companies. It is true that the cost of maintenance has been reduced greatly; that locomotives have been made heavier and more powerful; that freight cars carry three to four times as much as they did twenty-five years ago, so that the whole cost of operation is very much less than formerly. But where the carrier has gained one dollar the consumer and shipper have gained hundreds of dollars. Grain and flour can be brought from Chicago to the seaboard as cheaply by rail as by water; the farmer in Dakota raises wheat for shipment to Europe. Coal mined in West Virginia can be sold on the docks of New York at a profit for less than half the freight of twenty-five years ago. Our internal commercial relations have been changed, and the revolution is still incomplete. The influence of the Holley-Mushet-Bessemer process upon civilization is hardly inferior to that of the electric telegraph.

Sixty years ago an obscure German chemist obtained an oily liquid from coal-tar oil, which gave a beautiful tint with calcium chloride; five years later another separated a similar liquid from a derivative of coal-tar oil. Still later, Hofmann, then a student in Liebig's laboratory, investigated these substances and proved their identity with an oil obtained long before by Zinin from indigo, and applied to them all Zinin's term, Anilin. The substance was curiously interesting and Hofmann worked out its reactions, discovering that with many materials it gives brilliant colors. The practical application of these discoveries was not long delayed, for Perkins made it in 1856. The marvelous dyes, beginning with Magenta and Solferino, have become familiar to all. The anilin colors, especially the reds, greens and blues, are among the most beautiful known. They have given rise to new industries and have expanded old ones. Their usefulness led to deeper studies of coal-tar products, to which is due the discovery of such substances as antipyrin, phenacetin, ichthyol and saccharin, which have proved so important in medicine.

One is tempted to dwell for a little upon meteorology, that border land where phys-

ics, chemistry and geology meet, and to speak of the Signal Service system, the outgrowth of the studies of an obscure school teacher in Philadelphia, but the danger of trespassing too far upon your endurance makes proper only this passing reference.

While men of wealth and leisure wasted their energies in literary and philosophical discussions respecting the nature and origin of things, William Smith, earning a living as a land surveyor, plodded over England, anxious only to learn, in no haste to explain. His work was done honestly and slowly; when finished as far as possible with his means, it had been done so well that its publication checked theorizing and brought men back to study. His geological map of England was the basis upon which the British Survey began to prepare the detailed sheets showing Britain's mineral resources.

In our country Vanuxem and Morton early studied the New Jersey Cretaceous and Eocene, containing vast beds of marl. Scientific interest was aroused and eventually a geological survey of the State was ordered by the Legislature. The appropriation was insignificant and many of the Legislators voted for it hoping that some economic discovery might be made to justify their course in squandering the people's money. Yet there were lingering doubts in their minds and some found more than lingering doubts in the minds of their constituents. But when the marls were proved to contain materials which the chemist Liebig had shown to be all-important for plants the conditions were changed and criticism ceased. The dismal sands of eastern New Jersey, affording only a scanty living for pines and grasses, were converted, by application of the marl, into gardens of unsurpassed fertility. Vanuxem's study of the stratigraphy and Morton's study of the fossils had made clear the distribution of the marls, and the survey scattered the information broadcast.

Morton and Conrad, with others scarcely less devoted, labored in season and out of season to systematize the study of fossil animals. There were not wanting educated men who wondered why students of such undoubted ability wasted themselves in trifling employment instead of doing something worthy of themselves so as to acquire money and fame. Much nearer to our own time there were wise Legislators who questioned the wisdom of 'wasting money on pictures of clams and salamanders,' though the same men appreciated the geologist who could tell them the depth of a coal bed below the surface. But the lead diggers of Illinois and Iowa long ago learned the use of paleontology, for the 'lead fossil' was their guide in prospecting. The importance and practical application of this science, so largely the outgrowth of unappreciated toil in this country as well as in Europe, is told best in Professor Hall's reply to a patronizing politician's query: "And what are your old fossils good for?" "For this, take me blindfolded in a balloon; drop me where you will; if I can find some fossils I'll tell you in ten minutes for what minerals you may look and for what minerals you need not look."

Many regard Botany as a pleasing study, well fitted for women and dilletanti, but hardly deserving attention by strong men. Those who speak thus only exercise the prerogative of ignorance, which is to despise that which one is too old or too lazy to learn. The botanist's work is not complete when the carefully-gathered specimen has been placed in the herbarium with its proper label. That is but the beginning, for he seeks the relations of plants in all phases. In seeking these he discovers facts which often prove to be of cardinal importance. The rust which destroys wheat in the last stage of ripening, the disgusting

fungus which blasts Indian corn, the poisonous ergot in rye, the blight of the pear and other fruits, fall as much within the botanist's study as do the flowers of the garden or the Sequoias of the Sierra. Not a few of the plant diseases which have threatened famine or disaster have been studied by botanists unknown to the world, whose explanations have led to palliation or cure.

The ichthyologist, studying the habits of fishes, discovered characteristics which promptly commended themselves to men of practical bent. The important industry of artificial fertilization and the transportation of fish eggs, which has enabled man to restock exhausted localities and to stock new ones, is but the outgrowth of closet studies which have shown how to utilize Nature's superabundant supply.

The entomologist has always been an interesting phenomenon to a large part of our population. Insects of beauty are attractive, those of large size are curious, while many of the minuter forms are efficient in gaining attention. But that men should devote their lives to the study of the unattractive forms is to many a riddle. Yet Entomology yields to no branch of science in the importance of its economic bearings. The study of the life habits of insects, their development, their food, their enemies, a study involving such minute detail as to shut men off from many of the pleasures of life and to convert them into typical students, has come to be so fraught with relations to the public weal that the State Entomologist's mail has more anxious letters than that of any other officer.

Insects are no longer regarded as visitations from an angry deity, to be borne in silence and with penitential awe. The intimate study of individual groups has taught in many cases how to antagonize them. The scab threatened to destroy orange culture in California; the Colorado beetle seemed likely to ruin one of our important food crops; minute aphides terrified raisers of fruit and cane in the Sandwich Islands. But the scab is no longer a frightful burden in California; the potato bug is now only an annoyance, and the introduction of lady birds swept aphides from the Sandwich Islands. The gypsy moth, believed for more than a hundred years to be a special judgment, is no longer thought of as more than a very expensive nuisance. The curculio, the locust, the weevil, the chinch bug and others have been subjected to detailed investigation. In almost all cases methods have been devised whereby the ravages have been diminished. Even the borers, which endangered some of the most important timber species, are now understood and the possibility of their extermination has been changed into probability.

Having begun with the 'infinitely great,' we may close this summary with a reference to the 'infinitely small.' The study of fermentation processes was attractive to chemists and naturalists, each claiming ownership of the agencies. Pasteur, with a patience almost incredible, revised the work of his predecessors and supplemented it with original investigations, proving that a very great part of the changes in organic substances exposed to the atmosphere are due primarily to the influence of low animals or plants whose germs exist in the atmosphere.

One may doubt whether Pasteur had any conception of the possibilities hidden in his determination of the matters at issue. The canning of meats and vegetables is no longer attended with uncertainty, and scurvy is no longer the bane of explorers; pork, which has supplied material for the building of railroads, the digging of canals, the construction of ships, can be eaten without fear. Flavorless butter can be rendered delicious by the introduction of the proper bacteria; sterilized milk saves the lives of many chil-

dren; some of the most destructive plagues are understood and the antidotes are prepared by the culture of antagonistic germs; antiseptic treatment has robbed surgery of half its terrors, and has rendered almost commonplace operations which, less than two decades ago, were regarded as justifiable only as a last resort. The practice of medicine has been advanced by outgrowths of Pasteur's work almost as much as it was by Liebig's chemical investigations more than half a century ago.

In this review the familiar has been chosen for illustration in preference to the wonderful, that your attention might not be diverted from the main issue, that the foundation of industrial advance was laid by workers in pure science, for the most part ignorant of utility and caring little about it. There is here no disparagement of the inventor; without his perception of the practical and his powers of combination the world would have reaped little benefit from the student's researches. But the investigator takes the first step and makes the inventor possible. Thereafter the inventor's work aids the investigator in making new discoveries, to be utilized in their turn.

Investigation, as such, rarely receives proper recognition. It is usually regarded as quite a secondary affair, in which scientific men find their recreation. If a geologist spends his summer vacation in an effort to solve some perplexing structural problem he finds, on his return, congratulations because of his glorious outing; the astronomer, the physicist and the chemist are all objects of semi-envious regard, because they are able to spend their leisure hours in congenial amusements; while the naturalist, enduring all kinds of privation, is not looked upon as a laborer, because of the physical enjoyment which most good people think his work must bring.

It is true that investigation, properly so-called, is made secondary, but this is because of necessity. Scientific men in government service are hampered constantly by the demand for immediately useful results. Detailed investigation is interrupted because matters apparently more important must be considered. The conditions are even more unfavorable in most of our colleges and none too favorable in our greater universities. The 'literary leisure' supposed to belong to college professors does not fall to the lot of teachers of science, and very little of it can be discovered by college instructors in any department. The intense competition among our institutions requires that professors be magnetic teachers, thorough scholars, active in social work, and given to frequent publication, that, being prominent, they may be living advertisements of the institution. How much time, opportunity or energy remains for patient investigation some may be able to imagine.

The misconception respecting the relative importance of investigation is increased by the failure of even well educated men to appreciate the changed conditions in science. The ordinary notion of scientific ability is expressed in the popular saying that a competent surgeon can saw a bone with a butcher knife and carve muscle with a handsaw. Once, indeed, the physicist needed little aside from a spirit lamp, test tubes and some platinum wire or foil; low power microscopes, small reflecting telescopes, rude balances and home-made apparatus certainly did wonderful service in their day; there was a time when the finder of a mineral or fossil felt justified in regarding it as new and in describing it as such; when a psychologist needed only his own great self as a basis for broad conclusions respecting all mankind. All of that belonged to the infancy of science, when little was known and any observation was liable to be a discovery; when a Humboldt, an Arago or an Agassiz was possible. But

all is changed ; workers are multiplied in every land; study in every direction is specialized; men have ceased the mere gathering of facts and have turned to the determination of relations. Long years of preparation are needed to fit one to begin investigation ; familiarity with several languages is demanded ; great libraries are necessary for constant reference, and costly apparatus is essential even for preliminary examination. Where tens of dollars once supplied the equipment in any branch of science, hundreds, yes thousands, of dollars are required now.

Failure to appreciate the changed conditions induces neglect to render proper assistance. As matters now stand, even the wealthiest of our educational institutions cannot be expected to carry the whole burden, for endowments are insufficient to meet the too rapidly increasing demand for wider range of instruction. It is unjust to expect that men, weighted more and more by the duties of science teaching, involving, too often, much physical labor from which teachers of other subjects are happily free, should conduct investigations at their own expense and in hours devoted by others to relaxation. Even were the pecuniary cost comparatively small, to impose that would be unjust, for, with few exceptions, the results are given to the world without compensation. Scientific men are accustomed to regard patents much as regular physicians regard advertising.

America owes much to closet students as well as to educated inventors who have been trained in scientific modes of thought. The extraordinary development of our material resources—our manufacturing, mining and transporting interests—shows that the strengthening of our educational institutions on the scientific side brings actual profit to the community. But most of this strengthening is due primarily to unremunerated toil of men dependent on the meagre salary of college instructors or government officials in subordinate positions. Their aptitude to fit others for usefulness, coming only from long training, was acquired in hours stolen from sleep or from time needed for recuperation. But the labors of such men have been so fruitful in results that we can no longer depend on the surplus energy of scientific men, unless we consent to remain stationary. If the rising generation is to make the most of our country's opportunities it must be educated by men who are not compelled to acquire aptness at the cost of vitality. The proper relation of teaching labor to investigation labor should be recognized, and investigation, rather than social, religious or political activity, should be a part of the duty assigned to college instructors.

Our universities and scientific societies ought to have endowments specifically for aid in research. The fruits of investigations due to Smithson's bequest have multiplied his estate hundreds of times over to the world's advantage. He said well that his name would be remembered long after the names and memory of the Percy and Northumberland families had passed away. Hodgson's bequest to the Smithsonian is still too recent to have borne much fruit, but men already wonder at the fruitfulness of a field supposed to be well explored. Nobel knew how to apply the results of science; utilizing the chemist's results, he applied nitro-glycerine to industrial uses; similarly he developed the petroleum industry of Russia and, like that of our American petroleum manufacturers, his influence was felt in many other industries of his own land and of the Continent. At his death he bequeathed millions of dollars to the Swedish Academy of Sciences that the income might be expended in encouraging pure research. Smithson, Hodgson and Nobel have marked out a path which should be crowded with Americans.

The endowment of research is demanded now as never before. The development of technical education, the intellectual training of men to fit them for positions formerly held by mere tyros, has changed the material conditions in America. The surveyor has disappeared—none but a civil engineer is trusted to lay out even town lots; the founder at an iron furnace is no longer merely a graduate of the casting house—he must be a graduate in metallurgy; the manufacturer of paints cannot entrust his factory to any but a chemist of recognized standing; no graduate from the pick is placed in charge of mines—a mining engineer alone can gain confidence; and so everywhere. With the will to utilize the results of science there has come an intensity of competition in which victory belongs only to the best equipped. The profit awaiting successful inventors is greater than ever and the anxious readiness to apply scientific discoveries is shown by the daily records. The Röntgen rays were seized at once and efforts made to find profitable application; the properties of zirconia and other earths interested inventors as soon as they were announced; the possibility of telegraphing without wires incited inventors everywhere as soon as the principle was discovered.

Nature's secrets are still unknown and the field for investigation is as broad as ever. We are only on the threshold of discovery and the coming century will disclose wonders far beyond any yet disclosed. The atmosphere, studied by hundreds of chemists and physicists for a full century, proved for Rayleigh and Ramsay an unexplored field within this decade. We know nothing yet. We have gathered a few large pebbles from the shore, but the mass of sands is yet to be explored.

And now the moral has been drawn. The pointing is simple. If America, which, more than other nations, has profited by science, is to retain her place, Americans must encourage, even urge research; must strengthen her scientific societies and her universities, that under the new and more complicated conditions her scientific men and her inventors may place and keep her in the front rank of nations.

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RECENT PROGRESS IN MALACOLOGY.

The literature of the Rudistes in America is very scant. One of the important contributions to it that has yet appeared is due to Professor R. P. Whitfield,* who has recently described an interesting collection from the Cretaceous rocks of Jamaica. This comprises six species of *Radiolites*, one of *Caprina*, two of *Caprinella* and one of *Caprinula*. The descriptions are accompanied by excellent photo-engravings of the specimens, one of which reaches eighteen inches in diameter. In the same Bulletin† Professor Whitfield prints some extremely interesting observations on the problematical organism called *Barrettia*, first described by Woodward in 1862, from the Cretaceous limestones of Jamaica. The specimens which form the subject of the present article include, beside the original type of the genus, two new species which, with the others, are lavishly illustrated. *Barrettia* was first regarded as one of the Rudistæ though certain features analogous to coral structure were pointed out by Woodward. Whitfield's observations, though not claimed as decisive, lead in the latter direction and indicate that this singular fossil is probably related to the operculate corals, though from many points of view widely separated from any of the corals hitherto recognized as such. It may be mentioned that the

* Bull. Am. Mus. Nat. Hist. IX., Art. XI., pp. 185–196, Pl. VI.–XXII., New York, 1897.

† Op. cit., Art XX., pp. 233–246, Pl. XXVII.–XXXVIII.

peripheral structure of *Barrettia* strongly recalls that of some of the parasitic balani.

The year-book for 1896 of the Museum at Bergen, Norway, where so much excellent zoological work has been done in past years, by Daniellsen, Nansen and others, has recently been distributed. The leading paper in this volume* is an investigation of the eyes of *Pecten* and *Lima* by K. E. Schreiner. Anyone who has ever examined a living scallop has been struck by the jewel-like beauty of the brilliantly colored eyes on the edge of the mantle. These are shown by Schreiner to possess a rather high type of organization, the details of which are carefully worked out and fully illustrated. A considerable number of species was examined. On the other hand, the allied genus *Lima*, represented by the gigantic deep-water *L. excavata*, has a very low type of visual organ, a mere open pit lined with pigmented epithelium, much like the analogous organs in *Patella*. In the same volume† James A. Grieg contributes an article on the Vestland mollusks, including several nudibranchs new to the region. Anatomical details in regard to a variety of *Tritonia plebeia* are recorded. Felix Bernard has continued the excellent researches on the development of the hinge-teeth in bivalves, to which we have already called attention in an earlier number of this JOURNAL. In a recent number of the *Journal de Conchyliologie* ‡ he considers a small group of small bivalves for which is proposed the name Condylocardia, and with which he would unite the genera *Carditella* and *Carditopsis* in a special family Condylocardiidæ. These shells he considers to represent a precocious stage of development of the Carditidæ, Astartidæ and Crassatellitidæ. They have an internal resilium, and a striking feature is the near approach to symmetry of the early teeth with respect to the resilium. These small shells are also remarkable in the evidence they afford of the acceleration and retardation of certain characters relative to the time of appearance of such characters in allied groups. Another paper of more than ordinary interest* is on the Anatomy of *Chlamydoconcha orcutti*, a remarkable Californian bivalve, in which the valves are wholly internal and the adductor muscles so reduced that no trace of them remains. The work of M. Bernard in the main confirms the synopsis of characters given by the writer in 1884, exception being made of the anterior orifice of the mantle which proves to open into a *cul de sac* and may represent the point where the final immersion of the valves came to completion. A multitude of details are added to our knowledge of the animal and illustrated in the excellent manner usual with this author. The conclusion is that this mollusk represents the last term in a developmental series, of which *Galeomma* represents an early stage.

In a third paper† M. Bernard describes some interesting new forms, minute bivalves from New Zealand, belonging to the new genera *Pachykellya*, *Cyamiomactra* and *Perrierina*, with others belonging to *Neolepton*. All these are distinguished by marked peculiarities of the armature of the hinge, which are worked out with extreme care. These papers lead us to anticipate with the greatest interest the general work on the hinges of bivalves which M. Bernard has announced as in preparation.

Some years ago Carpenter described a curious little shell from Cape St. Lucas, which he named *Philobrya*, which appeared to be related to the pearl oysters. After-

* Bergen's Museums Aarbog for 1896, pp. 1–51, Pl. I.–IV., 1897.

† Op. cit., Art. X., pp. 32., with one plate.

‡ No. 3, pp. 169-206, 1897, with one plate.

* Ann. Sci. Nat. Zool. Ser. VIII., Vol. IV., pp. 321–252, Pl. 1, 1897.

† Extr. Bull. Mus. d'Hist. Nat. Paris, No. 7, pp. 309–314, 1897.

ward Vélain described another related shell from the islands of St. Paul and Amsterdam, under the name of *Hochstetteria;* and still more recently the writer made known another species of *Philobrya*, dredged by the Albatross on the Argentine coast, and called attention to the fact that the nepionic shell in this genus presented the characters of the *Glochidium* stage of the Unionidæ, and suggested that in *Philobrya* also this might correspond to an encysted parasitic stage. In an excellent paper on *Philobrya* and *Hochstetteria*, Bernard has added greatly to our knowledge, showing that the *Glochidium* in these genera represents a more advanced stage of development, including the presence of a provinculum, absent in the Unionidæ, and that the peculiarities of the shell are probably correlated with a large vitellus in the egg, rather than with any state of parasitic incubation. The soft parts in *Philobrya*, before the dissoconch is developed, have already passed the larval stage. These curious little shells, according to Bernard,* represent an early stage, not so much of any particular genus of Pteriidæ as of the group in general. It is certain, however, that the possession of a glochidial shell by both Unionidæ and the present group is a common character of no little significance, notwithstanding the fact that the inauguration of the dissoconch begins at slightly different stages in the two. Two systematic papers of unusual interest have recently appeared in the Transactions of the Connecticut Academy of Sciences. One by Professor Verrill † discusses the classification of the Pectinidæ, to which the author brings much erudition as well as a wide knowledge of the group. We believe that the subdivision of groups has been carried to an excessive minuteness, yet even this is preferable to the superficial study which slurs over points of difference without consideration. In the second paper Miss Bush * discusses the minute gastropods generally referred to *Cylostrema*, *Adeorbis*, *Vitrinella* and related genera. She shows that an enormous amount of confusion has reigned among them and does much to clear it up, incidentally describing quite a number of new groups to which portions of the assembly are to be referred.

* Journ. de Conchyl. Vol. 45, pp. 1–47, Pl. 1, 1897.

† Vol. X., pp. 41–96, Pl. XVI.–XXI, 1897.

Dr. H. von Ihering, the director of the museum at San Paulo, Brazil, has followed in the steps of Burmeister in his energetic efforts to elucidate the natural history of his adopted country. In the second volume of the Revista do Museu Paulista, recently received, with his report for the year 1897, beside articles on plants, crustaceans, insects and fishes of Brazil, he has published a review of the Arcidæ and Mytilidæ of the Brazilian coast, an enumeration of the molluscan fauna of the Brazilian island of San Sebastian, and one, which is perhaps the most timely of all, on the Mollusks of the Patagonian Tertiary, mostly referable to what Hatcher has so recently shown to be horizons of Miocene age. These are well illustrated with seven very good plates and numerous figures in the text.

The leisurely manner in which scientific publication proceeds in France is well illustrated by two instances which have lately attracted attention. One is the announcement of the final fasciculus of the monumental work of Crosse and Fischer on the land and fresh-water mollusks of Mexico, which is a report of the authors on material collected during the ill-fated expedition of Maximilian more than thirty years ago. To this has been added much from other sources and valuable anatomical work, indispensable to all students of the subject, as well as a wealth of illustration of the highest quality. We can only lament that the junior author did not survive to see the completion of the publication.

* Op. cit., pp. 97–144, Pl. XXII.–XXIII., 1897.

The other case is that of the Report on the Mollusks of the deep-sea dredging expeditions sent out by France, 1880–83, in the Travailleur and Talisman. The first volume of this report by Arnould Locard,* on the Testaceous Mollusks, includes the Cephalopods, Pteropods and Gastropods as far as Litiopidæ. It is illustrated by excellent lithographic plates and is chiefly descriptive. A superficial examination gives the impression that the abyssal fauna of the eastern Atlantic does not materially differ in character from that of the American border of the same ocean, but that, so far as it does differ, it confirms the impression that the abyssal mollusk fauna of any coast is strongly tinctured with the faunal characteristics of the shallow waters of that coast; so that, while there are some ubiquitous or almost ubiquitous species and many ubiquitous genera, the deep-sea fauna will eventually be divisible into almost as many provinces as there are recognizable among the different faunas of the sea margin.

We congratulate the author on the appearance of this weighty instalment of his work, and desire to assure him that we also know what it is to publish through a government printing office.

WM. H. DALL.

* 4°, pp. iv + 516, Pl. I.–XXII.; Paris, Masson et Cie., 1897.

ON THE LAW OF ANCESTRAL HEREDITY.†

THE Darwinian theory has for its main factor the perpetuation of favorable variations by natural selection under the law of heredity. Hence any complete quantitative treatment of evolution must deal: (1) with the nature and distribution of variation; (2) with the nature and influence of selection, and this not only upon the selected but upon all the correlated characters or organs; and (3) with the law of heredity. Earlier published and other written but unpublished papers of the present writer cover to some extent the ground of (1) and (2). Although the mathematical theory of variation and selection is yet very far from completion, the general lines on which it will proceed seem, to the present writer at any rate, fairly clear. With the law of heredity, however, the case has hitherto been different. Much has been written on the subject, much has been attributed to inheritance, but the quantitative measurements and facts have formed such a small and slender proportion of the whole that it has been extremely difficult to base a rounded mathematical theory on what is really known. It was with a view to the collection of further facts that the writer started his collection of Family Measurements, which would now have reached completion were it not that certain collateral relationships are still numerically somewhat deficient. Such facts are so all-important for real progress in our knowledge of heredity that the writer is convinced that there ought to be a comprehensive and systematic collection of them by some public body; the labor is beyond the powers of any unaided individual.

When the writer of the present paper wrote his memoir on Heredity, in 1895,* the only available material was contained in Mr. Francis Galton's *Natural Inheritance*, and in the data and measurements in Mr. Galton's hands, which he at once placed, with his usual generosity, at the writer's disposal. The very suggestive theory of heredity developed in the *Natural Inheritance* has two main features: (*a*) a theory of regression, which states the average proportion of any character which will be inherited under any degree of relationship. This theory was very simple; if the aver-

† 'Mathematical Contributions to the Theory of Evolution.' Abstract of a paper read before the Royal Society by Professor Karl Pearson, F.R.S., University College, London, January 27, 1898.

* *Phil. Trans.*, Vol. 187, A, p. 253.

age of the sons of any parent had w of the parent's deviation from the average parent, then the average grandson would have w^2 of the deviation, and so on. Collateral heredity was also determined, and for two brothers was found equal to $2w$. Mr. Galton's value of w was $\frac{1}{3}$.

(b) A law of ancestral heredity. According to this law the two parents contribute $\frac{1}{4}$, the four grandparents $\frac{1}{8}$, the eight great-grandparents $\frac{1}{16}$, and so on, of the total heritage of the average offspring. Mr. Galton, in 1889, considered this law to rest on a somewhat slender basis.*

In the *Philosophical Transactions* memoir of 1895 the writer started from the general theory of multiple correlation, and supposed the coefficient of heredity to be a quantity which had to be determined by observation for each pair of relatives and for each character. Mr. Galton's own data, when treated by the fuller mathematical theory developed in that memoir, seemed to demonstrate that fraternal could not possibly be twice filial inheritance. But if heredity be looked upon as a quantity to be determined by observation for each organ and each grade of kinship, *e. g.*, if there be no numerical relationship between direct and collateral heredity, then Mr. Galton's law of ancestral heredity must fall to the ground. Accordingly the writer, in 1895, discarded (b) and endeavored to develop (a) on the general basis of multiple correlation.

The recent publication of Mr. Galton's remarkable paper on ancestral heredity in Bassett hounds has, however, led the writer to reconsider (b). If the law be true, then for every organ and for every grade of kinship the amount of heredity is numerically determinable. The solution of the problem of heredity is thrown back upon the solution of an infinite series of linear equations. Their solution gives results which seem to

* *Natural Inheritance*, p. 136.

the writer in good agreement with all we at present know about the influence of heredity in various degrees of kinship. For example, fraternal is no longer *twice* filial regression, but has a value (0.3881) well in accordance with the writer's 1895 calculations on Mr. Galton's data. In short, if we discard Mr. Galton's relations between the regressions for various grades of kinship, and start solely from his law of ancestral heredity,* the whole theory of heredity becomes simple, luminous, and well in accordance with such quantitative measurements as have so far been made. That it confutes one or two purely hypothetical and semi-metaphysical theories is no disadvantage.

It is possible, and the writer believes desirable, to somewhat generalize the Law of Ancestral Heredity. Modifying Mr. Galton's definition of midparent, a conception is formed of the mid-sth parent, a sort of mean of the ancestry in the sth generation, and the contribution of this mid-sth parent to the offspring is assumed to have a constant ratio to that of the mid-$(s+1)$th parent, whatever be the value of s. With this simple law the whole of heredity is found to depend upon a single constant γ, termed the *coefficient of heredity.* γ may vary from organ to organ and from race to race. It may itself be subject to selection, if heredity be not looked upon as *a priori* given and antecedent to any evolution by natural selection. In Mr. Galton's statement of the law, $\gamma = 1$. This may really be the case, but it is not necessary to the theory, and it is not required by any facts as yet observed.

Given this simple law of ancestral heredity, there flow from it the following results :

* It may be *popularly* stated thus, each group of ancestry of the same grade contributes to the heritage of the average offspring double the quantity of the group of the grade above it.

(i) The values of all the correlation and regression coefficients between any pair of relations, *i. e.*, heredity between any grade of individual kinship. The chief of these are actually calculated in the paper.

(ii) The value of the stability that results from any long or short process of selective breeding, and the variability of the breed so established. A coefficient of stability is introduced in the paper and discussed at some length. The consideration of the more rapid influence of in- and inbreeding is postponed.

(iii) The law of cross heredity, *i. e.*, the degree of relationship between two *different* organs in kindred. It is shown that the coefficient of cross heredity for any pair of organs in any grade of kindred is equal to the product of the coefficient of direct heredity in that grade into the coefficient of organic correlation.

(iv) That simple panmixia without active reversal of natural selection does not lead to degeneration.

It may be of interest to add that since the law of ancestral heredity allows for the variability of each individual ancestor from the ancestral type, giving that variability its share in the heritage of the offspring, it is inconsistent with Weismann's theory of the germplasma. It does not, of course, answer one way or the other the question as to the inheritance of acquired characters.

To sum up, then, it seems to the present writer that Galton's law of ancestral heredity leads to, what has not hitherto existed, a rounded and comprehensive theory of heredity. It describes with surprising closeness all facts so far quantitatively determined, and opens up a wide range of conclusions which await testing by fresh data. Should those data be in agreement with its predictions, then the law of ancestral heredity will in the future play as large a part in the theory of evolution as the law of gravitation has played in planetary theory. It is the quantitative basis on which Darwinism, the evolution of species by natural selection *combined with heredity*, will then be placed; and at one stroke it will clear away a veritable jungle of semi-metaphysical speculations and hypotheses, and this for the simple reason that it is based upon quantitative observations and not on verbal subtleties. It will be difficult, perhaps, to make people realize that there is a science of heredity, simple and consistent, in existence; yet even at the present time it is the number of observers and experimenters, rather than the science, which needs to be strengthened.

THE ROYAL SOCIETY'S ANTARCTIC CONFERENCE.

THE Royal Society held an important meeting on February 24th for the purpose of discussing Antarctic exploration, which is at present engaging the attention of the British government. We take from the London *Times* the following account of the discussion:

Dr. John Murray, of the Challenger Expedition, said that, from a scientific point of view, the advantages to be derived from a well-equipped and well-directed expedition to the Antarctic region would, at the present time, be manifold. Every department of natural knowledge would be enriched by systematic observations as to the order in which phenomena coexist and follow each other in regions of the earth's surface about which we knew very little or were wholly ignorant. It was one of the great objects of science to collect observations of the kind indicated, and it might be safely said that without them we could never arrive at a right understanding of the phenomena by which we were surrounded, even in the habitable parts of the globe. Dr. Murray pointed out a fundamental topographical difference between the Arctic and Antarctic. In the northern

hemisphere there was a polar sea almost completely surrounded by continental land, and continental conditions for the most part prevailed. In the southern hemisphere, on the other hand, there was almost certainly a continent at the South Pole which was completely surrounded by the ocean, and, in those latitudes, the most simple and extended oceanic conditions on the surface of the globe were encountered.

With reference to the atmosphere, Dr. Murray said that one of the most remarkable features in the meteorology of the globe was the low atmospheric pressure at all seasons in the southern hemisphere south of latitude 45° S., with the accompanying strong westerly and northwesterly winds, large rain and snow fall, all round the South Polar regions. There were, he believed, many indications that the extreme South Polar area was occupied by a vast anti-cyclone, out of which winds blew towards the girdle of low pressure outside the ice-bound region. The anti-cyclonic area at the South Pole appeared to be permanent, and, when in winter the sea-ice was for the most part continuous, and extended far to the north, the anti-cyclonic area had most probably a much wider extension than in summer. All observations in high southern latitudes indicated an extremely low summer temperature. In winter we had no direct observations. It was most likely that the prevailing winds blew out from the Pole all the year round towards the surrounding sea, as in the case of Greenland; but, unlike Greenland, this area was probably seldom traversed by cyclonic disturbances. But what had been stated only showed how little real knowledge we possessed concerning the atmospheric conditions of high southern latitudes. It was certain, however, that even two years' systematic observations within these regions would be of the utmost value for the future of meteorological science.

Dr. Murray next dealt with the Antarctic ice. From many points of view it would be important to learn something about the condition and distribution of Antarctic sea-ice during the winter months, and especially about the position of the huge table-shaped icebergs at this and other seasons of the year. These flat-topped icebergs, with a thickness of 1,200 ft. or 1,500 ft., with their stratification and their perpendicular cliffs, rising 150 ft. or 200 ft. above and sinking 1,100 ft. or 1,400 ft. below the level of the sea, formed the most striking peculiarity of the Antarctic Ocean. Their form and structure seemed clearly to indicate that they were formed on an extended land surface and had been pushed out over low-lying coasts into the sea. Ross sailed for 300 miles along the face of a great ice-barrier from 150 ft. to 200 ft. in height, off which he obtained depths of 1,800 ft. and 2,400 ft. All Antarctic land was not, however, surrounded by such inaccessible cliffs of ice. Kristensen and Borchgrevink landed on a pebbly beach, occupied by a penguin rookery, at Cape Adare without encountering any land-ice descending to the sea. Where a penguin rookery was situated we might be quite sure that there was occasionally open water for a considerable portion of the year, and that consequently landing might be effected without much difficulty or delay; and, further, that a party, once landed, might with safety winter at such a spot, where the penguins would furnish an abundant supply of food and fuel. A properly equipped party of observers situated at a point like this on the Antarctic continent for one or two winters might carry out a most valuable series of scientific observations, make successful excursions toward the interior, and bring back valuable information as to the probable thickness of the ice-cap, its temperature at different levels, its rate of accumulation, and its motions, concerning all of

which points there was much difference of opinion among scientific men. Was there an Antarctic continent? Dr. Murray pointed out that the lithological specimens which had been collected from the floor of the Antarctic Ocean, dropped there from icebergs—gneisses, granites, mica-schists, quartziferous diorites, grained quartzites, sandstones, limestones and shales—were distinctively indicative of continental land, and there could be no doubt about their having been transported from land situated towards the South Pole. From these and from specimens, including fossils, from off the land itself, we were thus in possession of abundant indications that there was a wide extent of continental land within the ice-bound regions of the southern hemisphere. The fossil remains indicated in these areas a much warmer climate in past times. It was not likely that any living land fauna would be discovered on the Antarctic continent away from the penguin rookeries. Still, an Antarctic expedition would certainly throw much light on many geological problems.

Dr. Murray went on to speak of magnetic and pendulum observations, geodetic measurements, tides and currents. In any Antarctic expedition, he said, magnetic observations would, of course, form an essential part of the work to be undertaken, and the importance of such observations had been frequently dwelt upon by eminent physicists and navigators. It might be possible to measure a degree on the Antarctic continent or ice-cap, which would be a most useful thing to do. By watching the motions of the icebergs and ice from land at Cape Adare much would be learnt about oceanic currents, and our knowledge of the tides would be increased by a systematic series of tidal observations on the shores of the Antarctic continent, where we had at present no observations. The series of scientific observations here indicated would fill up many other gaps in our knowledge of the physical conditions of these high southern latitudes.

With regard to the depth of the Antarctic Ocean, the few indications which we possessed seemed to show that there was a gradual shoaling of the ocean from very deep water towards the Antarctic continent, and so far as we yet knew, from either soundings or temperature observations, there were no basins cut off from general oceanic circulation by barriers or ridges, similar to those found in the Arctic. Further samples in addition to those already obtained from different depths in the unexplored regions would yield most interesting information. As to the mean daily temperature of the surface waters of the Antarctic, all observations seemed to show that the surface water was warmer than the air during the summer months. After referring to the Challenger observations on surface and deep-sea temperatures, and to the relations between the Antarctic waters and those of the oceanic waters to the north, Dr. Murray stated that a fuller examination of these waters was most desirable at different seasons of the year, with improved thermometers and sounding machines. Dr. Murray referred in some detail to the pelagic and shallow-water life found in the Antarctic and Sub-Antarctic Ocean, and to the interesting scientific problems connected therewith. He dwelt especially on the many forms which have been found common to both the North and the South Polar Oceans, hinting at a problem of great interest which he discussed in the last volume of the 'Challenger' publications in connection with the former distribution of life in the ocean.

What was urgently required, he said, with reference to the biological problems indicated was a fuller knowledge of the facts, and it could not be doubted that an Antarctic expedition would bring back col-

lections and observations of the greatest interest to all naturalists and physiologists; and without such information it was impossible to discuss with success the present distribution of organisms over the surface of the globe, or to form a true conception of the antecedent conditions by which that distribution had been brought about. There were many directions, Dr. Murray concluded, in which an Antarctic expedition would carry out important observations besides those to which he had alluded. From the purely exploratory point of view much might be urged in favor of an Antarctic expedition at an early date. For the further progress of scientific geography it was essential to have a more exact knowledge of the topography of the Antarctic regions. This would enable a more just conception of the volume relations of land and sea to be formed, and in connection with pendulum observations some hints as to the density of the sub-oceanic crust might be obtained. In case what he had said might possibly have created the impression that we really knew a great deal about the Antarctic regions, it was necessary to re-state that all the general conclusions which he had indicated were largely hypothetical, and he again urged the necessity for a wider and more solid base for generalizations. The results of a successful Antarctic expedition would mark a great advance in the philosophy—apart from the mere facts—of terrestrial science. "No thinking person doubts," Dr. Murray concluded, "that the Antarctic will be explored. The only questions are—when, and by whom? I should like to see the work undertaken at once, and by the British navy. I should like to see a sum of £150,000 inserted in the estimates for the purpose. The government may have sufficient grounds for declining to send forth such an expedition at the present time, but that is no reason why the scientific men of the country should not urge that the exploration of the Antarctic would lead to important additions to knowledge, and that, in the interests of science among English-speaking people the United Kingdom should take not only a large but a leading part in any such exploration."

The Duke of Argyll, who was not present, but had sent a note on the subject, referred to the generally accepted glacial-period theory, with which he disagreed, and pointed out that the Antarctic continent was unquestionably the region of the earth in which glacial conditions were at the *maximum*, and therefore it was the region in which we must look for all the information attainable towards, perhaps, the most difficult problem with which geological science had to deal.

Sir Joseph D. Hooker (who was a member of Sir James Ross's expedition half-a-century ago) said that Dr. Murray's admirable summary of the scientific information obtainable by an organized exploration of the Antarctic regions left nothing further to be said under that head. He could only record the satisfaction with which he heard it read, and his earnest hope that it would lead to action being taken by the government in the direction indicated. Sir Joseph Hooker referred to the vast area of the unknown region which was to be the field for investigation—a region which in its full extension reached from the latitude of 60 S. to the Southern Pole, and embraced every degree of longitude. Referring to the vast ice-fields which covered the Antarctic area, Sir Joseph said that the explorer naturally asked where and how the components of these great fields of ice had their origin, how they arrived at or maintained their present position, what were their rate of progress and courses, and what was their influence on the surrounding atmosphere and ocean. That they orginated over extensive areas of open water in a higher latitude than

they now occupied, that they were formed of frozen ocean water and snowflakes, and that winds and currents had brought them to where we now found them was certain. But of the position of the Southern, open waters, with the exception of the comparatively diminutive sea east of Victoria Land, we knew nothing, nor did we know anything of the relative amount of snow and ice of which they were composed, or of their age, or of the winds and currents, that had carried them to a lower latitude. The other great glacial feature of the Antarctic area was 'the ice Barrier' which Ross traversed for 300 miles in the 78th and 79th degrees of south latitude, maintaining throughout the character of an inaccessible precipitous ice-cliff (the sea front of a gigantic glacier) of 150 ft. to 200 ft. in height. This stupendous glacier was, no doubt, one parent of the huge table-topped ice-island that infested the higher latitudes of the southern ocean; but, as in the case of the pack-ice, we did not know where the barrier had its origin, or anything further about it than that it rested in great part upon a comparatively shallow ocean-bottom. It probably abutted upon land, possibly upon an Antarctic continent. He did not see any other method of settling this important point, except by the use of a captive balloon—an implement with which he hoped any future Antarctic expedition might be supplied. He chose the subject of the Antarctic pack-ice as his theme not only because it was one of the very first of the phenomena that demanded the study of the explorer, but because it was the dominant feature in Antarctic navigation. The Antarctic fauna and flora were most important, for the South Polar Ocean swarmed with animal and vegetable life. So prolific was the Antarctic Ocean that the naturalist need never be idle, no, not even for one of the twenty-four hours of daylight throughout the Antarctic summer; and he looked to the results of a comparison of the oceanic life of the Arctic and Antarctic regions as the heralding of an epoch in the history of biology.

Dr. Nansen said that Great Britain was undoubtedly the country to undertake a great Antarctic expedition, for which the whole scientific world was now waiting impatiently. He confined his remarks to the portance of a land expedition. He was not at all sure whether the Antarctic land was a continent, and not a great group of islands. At all events there must be one or several ice-caps, and the exploration of these would yield scientific information of the greatest value. Geologists were looking to the Antarctic for full light to be thrown on the glacial epoch. It might be difficult to get on the Antarctic inland ice, but not at all impossible. The surface was probably smoother than in Greenland. Observations on the thickness of the ice would yield valuable results. On the other matters referred to by Dr. Murray he was confident that a properly equipped Antarctic expedition would yield excellent results. He pointed out the important influence in meteorology which this enormous ice-sheet must have on the climatology of the whole world. If Great Britain sent out such an expedition, he was sure that Norway would be willing to send out an expedition for cooperation upon the land. We know the conditions of polar exploration now so much better that we could much more readily lay our plans for investigating a region which had such a vast influence on the ocean which England was proud to rule.

Dr. Neumayer, Director of the Hamburg Observatory, said he considered it his duty to attend that meeting in order to show the value he placed on British Antarctic research in the past. He spoke of the urgent need which the science of terrestrial magnetism had of continuous observations in the Antarctic area, if possible simulta-

neously at several stations, by expeditions of various nationalities. He strongly advocated international cooperation, and this suggestion was warmly supported by the meeting. Antarctic exploration must be advocated, and strongly, on purely scientific grounds. Practical results to humanity would follow, as they always had followed scientific research in the past. Terrestrial magnetism was positively at a standstill for lack of *data* from the Antarctic. Dr. Neumayer pointed out, from the few observations made, the intensity of magnetism on the Australian side of the Antarctic compared with what had been found on the opposite side, and the curious coincidence of this with intensity of auroral phenomena. He spoke of Gauss's famous mathematical theory of magnetism, which had stood the test till now; but we were absolutely unable to form a physical theory until we obtained the necessary *data* from Antarctica.

Sir Clements Markham, President of the Royal Geographical Society, fully concurred with every word spoken by Dr. Murray on the subject of the scientific results, and more especially of the geographical results of an Antarctic expedition. It was quite sufficient to point out the vast extent of the unknown area; and that no area of like extent on the surface of the earth ever failed to yield results of practical, as well as of purely scientific, value by its exploration. But there was much more to be said in the present instance, because the little that we did know of the Antarctic regions pointed unmistakably to the very great importance and interest that was certain to attend further research. More complete examination was necessary before any approach to accuracy could be obtained respecting the nature and extent of the supposed ice-cap. We knew that the southern continent was a region of actual volcanic activity; but the extent, nature and effect of this activity remained to be ascertained. On the Antarctic circle, land had been sighted at numerous points, but it was unknown whether what had been seen indicated small islands or a continuous coastline. The extent of the ice-wall and the relations between that and the ice-cap were unknown; as well as the distribution of land and sea, and of ice and water in the summer, and the causes which influenced such distribution. The investigation of each one of these points, and of many others, would lead to further discoveries of the deepest interest to geographical science.

Dr. Alexander Buchan, Secretary of the Scottish Meteorological Society, emphasized the absolute necessity of further meteorological research in the Antarctic before we could form any satisfactory scheme of the climate of the globe.

Sir Archibald Geikie, Director-General of the Geological Survey, said that hardly anything was yet known of the geology of the Antarctic regions. By far the most important contributions to our knowledge of the subject were made by the expedition under Sir James Ross. But as he was unable to winter with his ships in the higher latitudes, and could only here and there with difficulty effect a landing on the coast, most of the geological information brought home by him was gathered at a greater or less distance from the land with the aid of the telescope. We did not know whether the land was a continent or a group of islands. There were indications of Paleozoic rocks, which emphasized the necessity for further research. Among the specimens brought home from Seymour Island in the same district were a few containing some half dozen species of fossil shells, which were believed to point to the existence of Lower Tertiary rocks, one of the organisms resembling a form found in the old Tertiary formations of Patagonia. Large well-developed shells of Cucullæ

and Cytherea undoubtedly indicated the former existence of a far milder climate in these Antarctic seas than now prevailed. If a chance landing for a few hours on a bare islet could give us these interesting glimpses into the geological past of the South Polar regions, what would not be gained by a more leisurely and well-planned expedition? But perhaps the geological domain that would be most sure to gain largely from such exploration would be that which embraced the wide and fascinating field of volcanic action. In the splendid harvest of results brought home by Sir James Ross one of the most thrilling features was the discovery of a volcano rising amid the universal snows to a height of more than 12,000ft., and actively discharging 'flame and smoke,' while other lofty cones near it indicated that they, too, had once been in vigorous eruption. Ross landed on one or two islands near that coast, and brought away some pieces of volcanic rocks. There was other evidence of past and present volcanic action on the Antarctic land. This region was probably one of the most interesting volcanic tracts on the face of the globe. Yet we could hardly be said to know more of it than its mere existence. The deeply interesting problems which it suggested could not be worked out by transitory voyagers. They must be attacked by observers stationed on the spot. Ross thought that a winter station might be established near the foot of Mount Erebus, and that the interior could easily be traversed from there to the magnetic pole. Another geological field where much fresh and important information might be obtained by Antarctic exploration was that of ice and ice-action. Our northern hemisphere was once enveloped in snow and ice, and though for more than half a century geologists had been studying the traces of the operations of this ice-covering they were still far from having cleared up all the difficulties of the study. The Antarctic ice-cap was the largest in the world. Its behavior could probably be watched along many parts of its margin, and this research would doubtless afford great help in the interpretation of the glaciation of the northern hemisphere. To sum up, geologists would hail the organization and dispatch of an Antarctic expedition, in the confident assurance that it could not fail greatly to advance the interests of their science.

Mr. P. L. Sclater, Secretary of the Zoological Society, considered it highly desirable to ascertain more exactly what forms of animal life were to be found on the Antarctic continent and in the adjacent seas. So far animal life in Antarctica has been found to be rather poorly represented. Most of the Antarctic specimens of these animals in our national collection had been obtained during the voyage of the Erebus and Terror, and were now antiquated. In his opinion the special point of interest in the zoology of Antarctica would be the further investigation of its extinct fauna. As in the North Polar region, so in the South Polar continent, it was already positively certain that animals of a character that could not under present conditions possibly exist there were formerly present. Further investigations into this subject would be likely to lead to most important results as regarded the climate of the Polar extremities of the earth in former ages, and would perhaps give us some ideas as to the date at which the ice-caps that now covered them originated. It was therefore of primary importance that in future Antarctic exploration great attention should be paid to the extinct fauna of the South Polar lands.

Professor D'Arcy Thompson (of the Behring Sea Commission) insisted upon the abundance of sea-life at least in the Antarctic, although we had only eight Antarctic dredgings. He believed there was an intimate connection between the Antarctic

and North Pacific, though not with the Atlantic. Admiral Sir William Wharton, Hydrographer to the Admiralty, said that an Antarctic expedition must be under naval discipline. He hoped such an expedition would not be far off, and he felt sure there would be rush of officers and men to join it. Sir John Evans, in summing up, said the discussion had maintained a high level. All were agreed as to the immense advantages of an expedition, and he was sure it would find a warm advocate in the Hydrographer.

ELLIS'S NORTH AMERICAN FUNGI.

TWENTY years ago Mr. J. B. Ellis, of Newfield, N. J., began the distribution of a most important series of volumes containing authentic specimens of the fungi of North America. Many botanists have availed themselves of the opportunity here afforded of securing excellent specimens of all groups of the fungi. For eight years Mr. Ellis worked alone, at the end of which he had issued fifteen volumes ('centuries'), each containing one hundred specimens. He was then joined by Mr. B. M. Everhart, and from this time the series bore the names of both authors. The announcement is now made that this work has been brought to a close.

The importance of being able to fix accurately the date of publication of each of the centuries is so great that the following statement by Mr. Ellis is given for the benefit of the readers of SCIENCE: Century I., September 6, 1878; II., April 15, 1879; III., February 11, 1880; IV., April 20, 1880; V., January 28, 1881; VI. and VII., May 23, 1881; VIII. and IX., April 13, 1882; X. and XI., April 26, 1883; XII. and XIII., April 15, 1884; XIV. and XV., March 25, 1885; XVI. and XVII., March 16, 1886; XVIII. and XIX., March 13, 1887; XX. and XXI., March 23, 1888; XXII. and XXIII., March 6, 1889; XXIV. and XXV., February 19, 1890; XXVI. and XXVII., February 21, 1891; XXVIII., April 30, 1892; XXIX., March 2, 1893; XXX., October 21, 1893; XXXI., April 18, 1894; XXXII., November 26, 1894; XXXIII., March 25, 1895; XXXIV., February 3, 1896; XXXV., December 16, 1896; XXXVI., February 1, 1898.

In regard to the foregoing Mr. Ellis says: "The dates on this sheet are the dates on which the centuries were sent to Charles E. Bessey. Usually when a century (or oftener two centuries) was ready only three or four were sent each day, so that some subscribers received their copies at a later date than others—from one to three weeks in some cases."

As to the number of copies of each century issued Mr. Ellis says: "I am not sure just how many copies of Century I. were issued, but I think there were thirty-five. The number was afterwards increased to forty, and then to fifty, and from Century XVII., to sixty." There were thus about two hundred thousand specimens in this great work. What wonder that the author upon whom the greater part of the labor has fallen should wish rest.

This notice would be incomplete without a reference to the part taken by Mrs. Ellis in the preparation of the volumes. The writer recalls a pleasant letter from Mr. Ellis shortly after the distribution began, in which he spoke of the fact that Mrs. Ellis now bound the books, and that they were better and neater than those of Century I., which came from a professional binder. From that time her hands made all the books (about two thousand), folded most of the papers for the specimens, and pasted the packets into the books.

While the distribution known as the 'North American Fungi' now comes to an end, the authors will continue for a time their second edition under the name of 'Fungi Columbiani.' This was begun in

1893, by the issuance on October 3d of centuries I. and II. Of this distribution sixty copies have been made of each century, and the centuries have now reached XII. This brings the total number of specimens handled in the two series up to about two hundred and seventy thousand.

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CURRENT NOTES ON ANTHROPOLOGY.

ALLEN ON HAWAIIAN SKULLS.

A CRANIOLOGICAL contribution of the first order of merit has just appeared in the Transactions of the Wagner Free Institute of Philadelphia, January, 1898. It is entitled 'A Study of Hawaiian Skulls, by Harrison Allen, M. D.' In this last labor of his busy and useful life Dr. Allen presented a model of patience, accuracy and clearness of statement which it would be difficult to parallel elsewhere. The characteristics of the skulls were exhibited comparatively, by a novel plan, that which he called the 'terrace method,' and which is a great improvement over the older graphic representatians.

With his customary, far-reaching insight into the problems of racial anatomy, Dr. Allen took occasion, in the description of these Polynesian specimens, selected from ancient cemeteries, drawn, therefore, from a single stock of undoubted purity, to point out the changes brought about in skull form by social contrasts, by mental superiority and by differences of nutrition. Comparing them with later crania from the stock, he discovered the singular alterations produced in the skull by exanthematous diseases; and many suggestions stimulating to future students are scattered through his pages.

PRIMITIVE COSMOGONIES.

IN the *Correspondenzblatt* of the German Anthropological Society, December, 1897, is a careful study by the Baron von Andrian on the cosmological and cosmogonical notions of primitive peoples. A wide collection of such myths and a critical analysis of their contents show in far separated centers many strange similarities. These, he argues, must be considered 'autochthonous,' *i. e.*, of independent origin, under the laws of thought and imagination. Later in time, when tribes commingled and the bards and priests sought to impart fixed forms to myths, borrowing arose over areas of varying size. It is the chief duty of the student of to-day to separate the 'common, psychological basic strata' from those which were added later by intercommunication. Quite late elements of mythology, such as the notion of the river Styx, or the tale of Orpheus and Euridice in Greek lore, belong to the primitive thought of the Hellenic stock and were not of alien origin. The article is replete with both erudition and suggestiveness.

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NOTES ON INORGANIC CHEMISTRY.

IT has long been known that that the composition of the 'green iodid' of mercury is far from constant, and is not that which would be theoretically required for mercurous iodid, HgI. Varet has considered that the mercurous iodid exists in two modifications, a green and a yellow, which can be changed the one into the other. The matter has been studied by Maurice François, who gives his results in the *Journ. pharm. chim.* The mercurous iodid is of a pure yellow color, and is readily obtained in this condition by the action of potassium iodid upon an excess of mercurous nitrate in the presence of dilute nitric acid. The green color of the salt as usually obtained is due to the presence of free mercury, which may run up to a very large proportion. It might not be without interest to

investigate how far this presence of free mercury affects the therapeutic value of a salt so largely used for medicinal purposes.

IN the *Comptes Rendus*, P. Ivon describes the use of calcium carbid as a test for absolute alcohol. If any water is present in the alcohol it decomposes the carbid with the evolution of acetylene. Calcium carbid may also be used for the dehydration of alcohol, one part being used to four parts of 90–95 % alcohol. Any acetylene dissolved in the alcohol is removed by anhydrous copper sulfate, and in one, or at least two, distillations the alcohol is rendered absolute.

THE atomic weight of boron is the subject of a paper recently read before the Chemical Society (London) by F. P. Armitage. The method used was the determination of the water of crystallization in borax. Great care was used, both in drying the crystals, so that there should be no efflorescence, and in dehydrating the crystals. The result obtained, 10.959 ($O = 16$), differs but 0.006 from that obtained by Ramsay and Aston by distilling sodium biborate with hydrochloric acid and methyl alcohol. In the discussion which followed the paper there was considerable criticism of depending upon water of crystallization in atomic-weight determinations.

AT the same meeting a paper was presented by E. Sonstadt on the dissociation of potassium chloroplatinate in dilute solutions and the production of platinum monochlorid. When the chloroplatinate is heated in a solution of 10,000 parts water the solution becomes turbid, and after some days' heating a precipitate is formed, yellow and non-crystalline, and consisting, according to the author, of hydrated platinum monochlorid, PtCl, while hydrogen peroxid is left in the solution. The monochlorid dissolves in solution of sodium carbonate and acids, but is deposited apparently unchanged by subsequent dilution. Much interest will attach to further study of this salt, not only from its being the only representative of univalent platinum compounds, but also from its method of formation by direct dissociation. J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE United States Fish Commissioner, Mr. George M. Bowers, has appointed Professor H. C. Bumpus, Brown University, Scientific Director of the Wood's Holl Station. Professor Bumpus is Secretary of the Trustees of the Marine Biological Laboratory at Wood's Holl, and in the past has been very closely associated with the work done there. His recognized scientific attainments and executive ability, as well as his local knowledge of Wood's Holl and the vicinity, make this a most admirable appointment, full of promise for the prosecution of the scientific and economic work of the Fish Commission under the present administration.

THE daily papers have contained columns and pages on the alleged discovery, by Professor Samuel Schenk, of the University of Vienna, of a method of regulating the sex of children, and on the alleged discovery, by Dr. George Waltemath, of Hamburg, of a second moon for the earth. It may consequently be desirable to state that Professor Schenk has made no publication bearing on the production of sex, and that no scientific evidence has been offered for the existence of a second moon.

PROFESSOR W. A. ROGERS, died at Waterville, Me., on March 1st, aged sixty-one years. He was assistant professor of astronomy in the Observatory of Harvard University from 1875 until 1886, when he accepted a call to the professorship of physics and astronomy at Colby University. He had expected to enter on a professorship at Alfred University, N. Y., on April 1st. Professor Rogers was a member of the National Academy, and a past Vice-President for the American Association for the Advancement of Science. He made important contributions to astronomy and physics, especially to the technique of measurement, of which we hope to give some account in a future number of this JOURNAL.

MR. W. WHITAKER, F.R.S., has been elected President of the Geological Society, London, succeeding Dr. H. Hicks, F.R.S.

A TESTIMONIAL in recognition of the services of Mr. Francis H. Webb as Secretary of the Institution of Electrical Engineers, London, was presented to him on February 1st. The testimonial took the form of a cheque for over £600, together with a diamond brooch for Mrs. Webb, and an illuminated address to Mr. Webb, was read by Mr. Henry Edmunds, the secretary to the committee.

THE Paris Société de Geographie has awarded its gold medal to M. Sven Hedin for his explorations in Central Asia to which we have already called attention.

THE Society of Colonial Studies of Brussels has received a gift of $5,000 to promote the study of the diseases of the Congo, and offers two prizes of $500, one for some notable addition to our knowledge of the evolution of the hæmatozoon of Laveran within and without the body, and the other for the discovery of the origin of hæmoglobinuric fever.

A PRIZE of $3,000, named in honor of Galileo Ferraris, will be awarded at the approaching exhibition at Turin for the most valuable invention exhibited for the application of electricity to industrial purposes.

THE ninth Congress of French Alienists and Neurologists will be held this year at Angers on August 1st and following days. The questions proposed for discussion are: (1) Post-Operative Psychical Disturbances; (2) The Part played by Arteritis in the Pathology of the Nervous System; (3) Transient Delirium from the Medico-Legal Point of View.

ON the motion of M. Brouardel, the Paris Academy of Sciences has appointed a commission to study the question of the propagation of tuberculosis. The commission is to consist of the six members of the section of medicine and surgery, the two permanent secretaries and MM. Brouardel, de Freycinet, de Jonquières, Chauveau, Duclaux, Arm, Gautier.

THE British government has decided to appoint a Royal Commission to inquire into the bacterial treatment of sewage.

PROFESSOR J. A. FLEMING, F. R. S., has begun a course of five lectures at the Royal Institution, London, on 'Recent Researches in Magnetism and Diamagnetism.' Friday evening discourses have been given by Captain Abney, F. R. S., on 'The Theory of Color Vision applied to Modern Color Photography,' and by Professor T. E. Thorpe, F. R. S., on 'Some Recent Results of Physico-Chemical Inquiry.'

THE following lectures will be delivered at the Royal College of Physicians of London: the Goulstonian Lectures—Dr. John Rose Bradford, on March 15, 17 and 22; 'Observations on the Pathology of the Kidneys.' Lumleian Lectures — Sir Richard Douglas-Powell, on March 24, 29 and 31, on 'The Principles which govern Treatment in Diseases and Disorders of the Heart.' The Milroy Lectures, which should have been delivered by Dr. S. Monckton Copeman, on 'The Natural History of Vaccinia,' on March 3, 8 and 10, are unavoidably postponed, owing to the illness of the lecturer, to May 3, 5 and 10.

THE teachers of chemistry in the Somerville district, Massachusetts, met at the Malden High School on February 9th, and listened to the following papers: 'The Harvard Requisition in Chemistry,' Charles R. Allen; 'Home Work for Quantitative Pupils;' 'Chemical Theory,' B. F. Holden; 'Note Books,' Emerton Rice; and 'Reviews,' by Clarence Boylston.

THE Onondaga tribe of Indians, which is the Wampum Keeper of the Six Nations, has notified the Regents of the University of the State of New York that the University has been designated as the Wampum Keeper of the tribe and the Wampum belts will consequently be deposited in the State Museum.

THE Maryland Legislature has passed, by a vote of 65 to 20, the bill allowing the Trustees of the Sheppard Asylum to alter the name of the Institution to the Sheppard and Enoch Pratt Hospital in order that the institution may receive the one and-a-half million dollars bequeathed by the late Enoch Pratt.

THE Post-Office Department has ordered 25,000,000 postal cards of the standard library size intended for card indexes.

THE first meeting of the British Royal Com-

mission for the Paris Exposition of 1900 was held on February 18th, at Marlborough House. The Prince of Wales, the chairman, made an address, in the course of which he said that the exhibits will be divided into 18 groups, comprising 120 classes, in which provision will be made for the display of every kind of art, industry and manufacture. The guiding principle is that similar products, from whatever part of the world they may come, should be shown side by side, and in this respect the Exhibition of 1900 will differ from its predecessors, in which the products of each country have usually been collected together. The arrangement, though less favorable to a striking national display, has many advantages, and admits of a ready comparison of the arts and industries of one country with similar arts and industries of others. The Prince of Wales stated that in comparison with the appropriation of Germany, £250,000, and of Switzerland, £66,000, that of Great Britain was inadequate, and he hoped that the Treasury might be prevailed upon to increase it.

An international exhibition of products, of industry and aliments is to take place at Prague from the 15th to the 22d of May, this year. The exhibits will include all industrial products, food articles, eatables, and all kinds of beverages, hygienic and pharmaceutic products, general novelties, inventions and sporting accessories.

At its annual meeting, Feb. 2d, the Russian Geographical Society awarded, says *Nature*, a special Constantine medal to Dr. Nansen; a Constantine medal to V. I. Roborovsky, for his journeys in Central Asia; the Count Lütke's medal to I. I. Strelbitzky, for his journeys in Persia and Manchuria in 1891–96; the new Semenoff's medal to Dr. Sven Hedin, for his three years' journeys in Central Asia. A large gold medal of the Society was awarded to I. K. Zhdanoff, for his ethnological works, and especially for work on 'Russian Epical Poetry,' and small gold medals to Th. Witram, for pendulum measurements in the far East; to F. Sperck, for his large work on the climate of the Astrakhan region; to S. Rybakoff, for the collection of specimens of musical texts of songs amongst the Ural natives; and to S. Gulishambaroff, for his work 'The World's Trade in the Nineteenth Century and Russia's Part in it.' Silver medals were awarded to MM. Pastukhoff, for his ascension of the Elbrus; Abels, for hypsometrical measurements in the Urals; D. A. Fedchenko, for a communication on the Talas Alatau; Timonoff, for a paper on the water-communications on the tributaries of the Amur; Sapozhnikoff, for work on the glaciers of the Altai; Kovanoko and Semkovskiy, for the organization of international balloon ascensions in which the Society took a part; and to Prince Obolensky, Tomilovskiy and Utyesheff, for their daily observations upon the motions of the clouds.

The London correspondent of the New York *Evening Post* cables that the polar expedition upon which the Duke of the Abruzzi will start this summer will be both expensive and extensive. King Humbert contributes $100,000; the Duke devotes his whole income of $30,000 a year to the object, and, if necessary, also will draw upon his capital. After leaving Franz Josef Land, on foot or in sledges, the expedition will establish posts along the route. The Duke takes twenty experienced Italians, fifty Esquimaux and a number of dogs.

The German Antarctic Expedition Committee have decided to send an expedition to the South Polar regions under the direction of Dr. Erich von Drygalski.

Secretary Wilson, of the Agricultural Department, in pursuance of his determination as far as practicable to utilize the agricultural seed appropriation in securing 'new, rare and valuable' seeds, dispatched Professor Nilse E. Hansen, professor of horticulture at Brookings, S. D., to eastern Europe and Asia to secure new seeds and plants. Professor Hansen is now preparing his report for publication, after an extended trip through eastern Russia, Trans-Caucasia, Russian Turkestan, western China and Siberia. Many promising varieties were obtained, and about three car-loads of seed will be distributed to State experiment stations and others. These seeds, it is expected, will be chiefly of value in the arid regions, the purpose of Professor Hansen's trip being to ob-

tain such as were distinguished for resistance to drought and heat.

A MAP of Alaska, showing known gold-bearing rocks, with descriptive text containing sketches of the geography, geology and gold deposits and routes to the gold fields, has just been issued by the U. S. Geological Survey, in pursuance of a recent joint resolution of Congress. These pamphlets are to be had for the asking. There will be 40,000 copies in all. Most of them go to the Congressional document rooms, whence they will be distributed to the public on orders of Senators and Representatives; the remainder issue from the Survey office. The map, which is on a scale of 57 miles to the inch, is specially designed for the use of the miners, prospectors and travelers in Alaska. The region represented extends from Bering Strait eastward to the Rocky Mountains and British Columbia, and from the 54th parallel northward to the Arctic Ocean, embracing the drainage basin of the Yukon River from its mouth to its most distant headwaters. The principal topographic features, as plateaus, mountain regions and valleys, are indicated by hachures. More is known of the valleys and regions bordering the navigable drainage ways than of other portions of the country. Back from the rivers lie extensive rugged tracts still comparatively unexplored. The lines of magnetic variation are laid down. The Fort St. Michael Military Reservation, on the coast, is outlined. The center of this reservation is St. Michael Island, and it includes the great delta of the Yukon, the head of Norton Sound and Golofnin Bay. The map includes two smaller, local, larger-scale maps, one of the Fortymile and the Klondike gold-mining regions, the other of the mountainous area between the coast and the interior above Linn Canal, showing the passes, routes and trails leading from tide water to the headwaters of the Yukon. It is in part colored, showing at a glance by color and by name where gold and coal have been found, in both the interior and the coastal regions, especially the gold-bearing rock formations of the Fortymile and Birch Creek series. These gold-bearing rocks are seen to trend from the Klondike region for nearly 600 miles northwestward, across the great elbow of the Yukon, toward the coast. The descriptive text accompanying the map, consisting of 44 pages, contains useful information for the practical prospector and miner. It gives a brief historical, geographical and geological sketch of the country, describing its rivers, mountains, climatic conditions, routes, trails and passes, with valuable hints and directions to the traveler down the Yukon concerning the canyon and the dangerous White Horse Rapids. Besides the rock formations of the Fortymile and the Birch Creek series, the original deposits, or gold-bearing quartz veins, are broadly discussed and the probable extent of the gold deposits is indicated. Similar consideration is given to the detrital, or gold-bearing placer gravels, and to the mode of concentration of the coarse gold, its nature, and the manner of its extraction. Valuable metals other than gold, as platinum and copper, are also touched upon. The deposits of coal and lignite are mentioned somewhat fully. They occur mostly in the coastal regions and on the Lower Yukon, though good coal is also found in the Fortymile district, as on Coal Creek. Similar deposits have also been reported on the headwaters of the Stewart River, just above the Klondike.

IT is expected that the Dictionary of Philosophy edited by Professor J. Mark Baldwin, of Princeton University, and published by The Macmillan Company, will appear early in 1899. The staff of the Dictionary, as now organized, is as follows. Consulting Editors:

English: Professors H. Sidgwick, Andrew Seth and William James; *German:* Professors Windelband, Ziehen, Exner, Münsterberg; *French:* Professors Pierre Janet, L. Marillier, Th. Flournoy and Yves Delage.

Writers in charge of departments, as follows: *Philosophy:* Professors Josiah Royce, Andrew Seth and John Dewey; *Logic:* Professor Adamson; *Ethics:* Professors Sorley and James Seth; *Psychology:* Mr. Stout, Professors Cattell, Titchener and Baldwin; *Philology:* Professor Wheeler; *Physical Science and Mathematics:* Professors Simon Newcomb and H. B Fine; *Mental Pathology and Anthropology:* Professor Jastrow; *Biology:* Professors C. Lloyd Morgan and Minot; *Physiology:* Professor Hodge; *Economics:* Professor Hadley; *Political and Social Philosophy:* Professor Montague, Dr. James Bonar, Professor Giddings; *Jurisprudence and Law:* Judge S. E. Baldwin;

Philosophy of Religion: Professors A. T. Ormond and R. M. Wenley; *Education:* President De Garmo; *Æsthetics:* Professors Tufts and James Angell; *Neurology:* President C. L. Herrick, Dr. C. J. Herrick; *Bibliography:* Dr. Benj. Rand, Professor H. C. Warren; *Biography:* Professor G. A. Tawney; *Editor's Assistants:* Professor G. A. Tawney, Dr. W. M. Urban.

WE learn from *Cosmos* that the railway to the summit of the Jungfrau is being carried forward in spite of the cold weather. One of the mountain streams has been utilized, giving 2,400 h. p. which is used to drive by electric motors the drills excavating the tunnel, which has been carried a distance of eighty meters.

THE Bulletin of the Iron and Steel Association has made public the figures for the consumption of pig iron in the United States and its production since 1889 and including 1896, thus:

Years.	Actual production. Gross tons.	Estimated consumption. Gross tons.
1889	7,603,642	7,755,093
1890	9,202,703	8,943,338
1891	8,279,870	8,366,728
1892	9,157,000	9,303,315
1893	7,124,502	6,982,607
1894	6,657,388	6,694,478
1895	9,446,308	9,628,572
1896	8,623,127	8,275,774

It is a little too soon to estimate fully our consumption of pig iron in 1897, the import and export statistics of pig iron for the whole year not being as yet available, but a very close approximation to actual results is possible. We produced in that year 9,652,680 gross tons and imported say 18,000 tons. The imports in the first eleven months were 16,327 tons. At the beginning of the year there was on the market 847,686 tons of pig iron. The total supply for the year was, therefore, approximately, 10,518,366 tons. Of this total supply we exported about 260,000 tons. The actual exports in the first eleven months were 236,502 tons. There were on the market at the close of the year 874,978 tons. Deducting these two items from the total supply we have 9,383,388 tons as the approximate consumption of the year. This quantity is about 245,000 tons less than the consumption of 1895, and not very much in excess of the consumption of 1892. For the per capita consumption we have, as the 'index of civilization,' about 250 pounds per annum, which we think is unexcelled by the consumption of any other nation.

THE French Automobile Club will hold an international motor-car and carriage exhibition, in Paris, June 13th to July 3d, inclusive; and the regulations have just been issued. The exhibition is to be divided into the following seven sections: (1) motor cars and motor cycles, (2) motors, (3) tyres, (4) carriage work for motor-vehicles, (5) motor-car parts, fittings and accessories, (6) tools, etc., for motor-vehicle builders, (7) motor-car literature. Intending exhibitors may apply to Messrs. Thevin & Houry, Bureau de l'Exposition, 4 Place de l'Opera, Paris. Space is already announced to be limited and early application only can insure assignment.

THE Committee on Medical Expert Testimony, of the New York Academy of Medicine, has stated, in reporting progress, that it had been determined that improvement in the system of expert medical testimony must proceed along three lines, viz.: (1) the establishment of some standard of excellence for experts; (2) the appointment of the experts for given cases by the presiding judge, and (3) the fixing of the fees by the Court and the deposit of a certain portion of the sum in advance. It was recommended that those registering as experts before the Board of Regents should be required to specify the particular branch of medicine; that they should have been in practice ten years, and in the practice of their specialty for five years; that evidence of special study should be presented, together with a certificate of good moral character, and indorsements by the local county medical organization and a judge of a court of record.

WE learn from the *Lancet* that the annual meeting of the Royal Zoological Society of Ireland took place on January 25th, at the Royal College of Physicians, at Dublin. The report of the Council showed that the popularity of the the gardens, as a place of resort, was increasing, as proved by the rise in the gate receipts. In February, 1897, a deputation waited on Mr. Hanbury, at the Treasury, for the purpose of

pressing the claims of the Society to a grant, it being over ten years since the Science and Art Department had conferred on it the sum of £3,000, long since expended in the erection of buildings and in improvements in the gardens. In last March the Aquarium House was formally reopened by Her Excellency, the Countess Cadogan. The committee, headed by Dr. Samuel Gordon and Lord Powerscourt, having for its object the erection of a memorial building to bear the name of the former Honorable Secretary of the Society, the late Dr. Samuel Haughton, has received much public sympathy and support.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. JOSEPH F. LOUBAT has given to Columbia University property valued at $1,000,000, subject to a life annuity of $60,000. This great sum is for the support of the library, and is to be named the 'Gaillerd-Loubat Library Endowment Fund.'

THE bill has been presented in the Maryland House of Delegates appropriating $100,000 to the Johns Hopkins University. President Gilman has made a statement in which he explains how the income of the University has been decreased by the failure of the Baltimore & Ohio Railroad; in 1896–97 the income exclusive of the medical school and certain gifts given for special purposes was:

From investments	$50,796 44
Tuition	47,512 09
Relief fund of 1896	57,424 01
Rents	21,432 22
Total	$177,164 76

Expenses of the University were $191,156. The buildings, land and equipment of the University are valued at slightly over a $1,000,000.

THE Board of Trustees of Lafayette College have decided to rebuild Pardee Hall, the building containing the scientific departments, recently destroyed by fire, and to erect a chemical laboratory at a cost of $25,000. Towards the cost of this building $10,000 was subscribed at the meeting.

DR. E. D. PEARSONS, of Chicago, has donated $25,000 to Pomona College, Pomona, Cal., which will be used by the trustees for the erection of a new science building.

THE Jefferson Medical College, Philadelphia, has received, by the will of the late C. D. Shain, $7,000 for scholarships and prizes.

THE annual report of the Board of Regents of the University of the State of New York states that the colleges and professional and technical schools of the State in seven years have increased their expenditures from $2,733,860 to $5,771,325; the value of buildings and grounds, from $15,129,028 to $28,447,974; the libraries and apparatus, from $1,896,959 to $3,542,456, and the total property owned, from $39,045,604 to $77,148,944.

THE London University Commission Bill was introduced into the House of Lords by the Lord President of the Council on February 21st. It is identical with the bill of 1897, except that the names of the commissioners are not included.

THE Austrian government has compromised with the rioting university students by suspending the lectures for the balance of the semester, but permitting them to count the time as spent in residence. At the commencement of the summer semester on March 21st all students will be required to renew their pledge to observe the academic regulations.

PROFESSOR RUSSELL H. CHITTENDEN, without resigning his professorship in Yale University, has accepted the directorship of the department of physiological chemistry in Columbia University. Dr. W. J. Gies has been appointed instructor and Messrs. A. H. Redland and H. E. McDermott have been appointed assistants in the department.

PRESIDENT A. S. DRAPER, of the University of Illinois, has been offered the superintendentship of schools of New York City.

PROFESSOR LUIGI LOMBARDI has been appointed professor of technical physics at the Industrial Museum of Turin, in the room of the late Professor Galileo Ferraris.

DISCUSSION AND CORRESPONDENCE.

MUSCULAR DISTURBANCES IN MONOCULAR VISION.

IN a recent number of SCIENCE (February 25 1898) Mr. Charles H. Judd recounts some in-

teresting experiments on 'Binocular Factors in Monocular Vision.' This title is somewhat misleading. The essential characteristic of binocular vision consists in the simultaneous formation of slightly dissimilar images on the two retinas, with corresponding modification of the perception of depth in space. Mr. Judd's experiments relate to variation in direction of the two visual lines, with resulting production of double images; but fusion of these images is an indispensable requisite for the attainment of any binocular perception.

It is well known that most persons fail to perceive double images as phenomena attendant upon binocular vision. To perform binocular experiments the observer must have some training in the muscular control of the eyes, and also in visual perception. Such experiments occupied much of my attention some years ago (*American Journal of Science*, 1881–1883). In performing the first experiment described by Mr. Judd it is very easy to catch the heteronymous image, and by proper control of the eye to stop its motion instantly. The appearance of unrest of the object, to which he refers, is due to the motion of this image during the instant before fusion is attained. The visual line of the closed eye, as Mr. Judd correctly observes, does not converge toward that of the open eye. Since fusion of images is attained in natural binocular vision and without any conscious effort, on suddenly opening the unused eye, unconscious motion of both eyes results until fusion is secured. But the vision is strictly monocular until such fusion is completed, and the momentary illusion is not a binocular factor in such vision.

The experiment is perhaps most easily accomplished by covering one eye with the hand and suddenly removing this, instead of bringing the muscles of the eyelids into play. If the open eye be directed to some well illuminated object of known diameter and at a known distance, such as a clock dial, the angular displacement of the heteronymous image is easily found. It is only necessary to control the unused eye, resisting the tendency to secure fusion and noting the interval between corresponding edges of the two overlapping images. The ratio of this to the distance gives the angle.

The unused eye will in most cases be so directed that the two visual lines are approximately parallel. In cases of strabismus, external or internal, this parallelism is, of course, lost, but in such cases there is usually no power of binocular perception, one eye being habitually depended upon to the exclusion of the other.

When control of the eyes is lost temporarily through drowsiness the uncontrolled relation of the visual lines may be ascertained by winking one eye, if the observer is enough interested in binocular experiments to remember this, and to do this, in his semi-conscious condition. I have done so repeatedly, and have always found in my own case that the double images were homonymous; which indicates that the visual lines were crossed instead of divergent. I have watched the eyes of others under such conditions. In some cases the contraction of the rectus muscles was seen to be internal, in others external. No general rule on this subject can be formulated. It seems highly probable, however, that after consciousness becomes complete all the rectus muscles are completely relaxed, with more or less divergence of visual lines. By the aid of stereographs upon which the stereographic interval exceeds the observer's interocular distance, binocular vision by optic divergence is readily attained after a reasonable degree of muscular control of the eyes has been attained by practice. But for obvious reasons the external rectus muscles are comparatively but little under the control of the will, and 7° or 8° of such divergence is probably about a maximum for normal eyes.

I have elsewhere shown (*Am. Jour. Sci.*, May, 1882) that the ciliary muscle is also subject to the control of the will, though its action is most generally automatic. My observation accords with that of Mr. Judd that vision with a single eye is rarely if ever equal in distinctness to that with two eyes. But the accommodation of the single eye improves with time.

W. Le Conte Stevens.
Rensselaer Polytechnic Institute,
Troy, N. Y.

THE NORTHERN DURCHMUSTERUNG.

The Durchmusterung charts of the northern

sky are indispensable to every active astronomical observatory and to every astronomer who wishes to study the fainter stars. Unfortunately, the original edition of this work is exhausted, so that copies can no longer be supplied. A new edition is being prepared by the Bonn Observatory, and will be published shortly, provided that subscriptions for a hundred copies, at seventy Marks each, are promised before May 1, 1898. The price is very low, considering the amount of material furnished. After that date the price will be raised to one hundred and twenty Marks. The Astronomical Conference held at the dedication of the Yerkes Observatory appointed the undersigned a committee to aid this project. Orders for copies may be sent to the publishers, Messrs. A. Marcus and E. Weber, Bonn, Germany, or will be transmitted to them by any member of the committee. It is proposed to publish a list of American subscribers, and it is hoped that at least fifty copies will be taken by American astronomers. Since charts deteriorate rapidly by constant use several copies should be taken by each of the larger observatories. The members of the committee have shown their appreciation of the value of this work by ordering twelve copies for use in the institutions under their direction. It is of the greatest importance that the subscription list should be filled, as it is probable that in the future many similar enterprises may be undertaken, whose success will depend upon that now attained.

EDWARD C. PICKERING,
J. H. HAGEN, S. J.,
M. B. SNYDER,
Committee.

SCIENTIFIC LITERATURE.

Theoretical and Practical Graphics. By FREDERICK N. WILLSON, C.E., A.M., Professor in the School of Science, Princeton University. (Author's Edition.) 1897. 4to. Pp. viii + 264 + Appendix.

This is a most attractive work, not only conquering elementary graphics entire, but containing much more of highest geometric interest, including a fairly complete course on higher plane curves.

The part of the subject where Church so long held supremacy in America, with his Descriptive Geometry, justly appreciated for its elegance, is paralleled by Professor Willson in his chapter I. and chapters IX.–XII., 117 pages in all, including 219 figures in the text, where he not only covers with equal conciseness and elegance the matter of Church's 138 pages of text and 21 pages of illustration (102 figures), but in addition has treated many new and important matters, such as the Conoid of Pluecker (articles 333, 356, 477), a favorite surface of Sir Robert Ball, applied in his Theory of Screws, which itself may be looked upon as in part an application of non-Euclidean geometry, also the Cylindroid of Frézier (§§ 333, 360, 489), the corne de vache (§361, 475–6), and some special helicoids (§ 480–4), and also has covered the Third Angle (or 'shop') method of employing descriptive geometry, and given a very full treatment of development (§§ 405–20). The mathematical surfaces are beautifully illustrated.

The general plan of the book, while providing a comprehensive graphical training in the form of a progressive course, admits of specialization, of shorter courses, with noticeable flexibility. In fact, eight sub-groupings are indicated for independent courses. Comparison with the special treatises scrupulously cited shows the extent of matter on all topics usually treated to be surprisingly great. Professor Willson has a gift for condensing without loss of clearness.

With this power, he does well to restate for convenient reference many of the fundamental definitions which he presumes already in some form previously mastered—for example, the definition of the trigonometric functions on p. 31.

But I still prefer the definition in the note on p. 121, "A straight line is the line which is completely determined by two points:" to the author's second thought given in the preface, "The line that is completely determined by any two of its points." The spheric space of non-Euclidean geometry, though movable as a whole in itself, is such that two geodetic lines in it always cut in two points.

Of course, no spherical trigonometry is employed in the author's solution of the problems of trihedrals, purely a graphic process, as it should be. We are glad to find as an appendix

the author's brief but weighty paper on Trochoids which was presented before the American Association for the Advancement of Science a few years since. We cannot forbear to dwell upon the superb illustrations, which make the book a portfolio of art. The author is particularly happy in deciding conflicts of nomenclature, as where he refuses to follow Javary (§ 508) in calling the geodesic on a cone a conical helix.

The author has been extraordinarily painstaking in the proof-reading, and the book is practically free from error. A few trifles have been noticed: Page 156, § 433, first line, for 'prism' read 'cylinder.' Page 171, § 442, first line, for 'axes' read 'bases.' Page 37, sixth line from below, for 90° read 9°. Page 67, § 194, seventh line, for φ read θ.

The slip on page 55, § 166, in stating the brachistochrone and tautochrone properties of the cycloid, is so evidently a reference to a reversed or inverted line inadvertently omitted that it also is trivial. As the briefest hint of contents by chapters: I., definitions. II., freehand sketching. III., draughtsman's outfit. IV., use of instruments. V., higher plane curves. VI., conventional representations. VII., lettering. The treatment of lettering is particularly full and 64 alphabets are given. VIII., copying processes. IX., Descriptive Geometry of Monge. X., projections, intersections, development of surfaces, with applications to elbow joints, blast pipes, arch constructions, etc. XI., trihedrals. XII., projection of sphere. Here the now disused orthographic projection is somewhat condensed, but the stereographic, which is used, is treated at compensatory length. XIII., shades and shadows. XIV., perspective. XV. and XVI., isometric and clinographic projection, with applications; also crystals in oblique projection. XVII., bridge details, toothed gearing, etc. Out of a host of beautiful figures we may mention 92 as particularly efficient in teaching homology or *complete plane perspective.*

It is a particular pleasure to welcome the book, because it is on just the lines where English and American mathematics has hitherto been sterile.

Even now the tremendous, the fundamental importance of von Standt's geometry of position, the pure projective geometry, both for science and philosophy, is realized by few. For example, in the Bolyai type of non-Euclidean geometry, not only is the straight line infinite, but also it has two distinct points at infinity; it is never closed, even by points at infinity. Writing in 1835, even the superhuman penetration of Lobachévski attributed this essential openness to the straight in itself. In the introduction to his 'New Elements of Geometry,' he says: "I consider it unnecessary to analyze in detail other assumptions too artificial or arbitrary. Only one of them still deserves some attention, namely, the passing over of the circle into a straight line. Moreover, here the fault is visible from the beginning in the violation of continuity, when a curve which does not cease to be closed, however great it may be, must change immediately into the most infinite straight line, since in this way it loses an essential characteristic.

In this regard the imaginary geometry [the non-Euclidean geometry] fills out the interval much better. When in it we increase a circle all whose diameters come together at a point; finally we so attain to a line such that its normals continually approach, although they no longer can cut one another. This characteristic does not pertain to the straight, but to the curve which, in my paper 'On the Foundations of Geometry,' I have called *circle-limit.*"

Of course, it was not until in the next decade (1847) that von Standt published his immortal 'Geometrie der Lage,' but long afterward Helmholtz suffers still more seriously for lack of the pure projective geometry, treating the projective questions which necessarily came up in his extended optical researches, sometimes by means and methods of his own make, sometimes only by general reasonings.

Again, in *Mind* (1876) Helmholtz misses thus a fundamental difference. He says, p. 315: "It is, in fact, possible to imagine conditions for bodies apparently solid such that the measurements in Euclid's space become what they would be in spherical or pseudospherical space. * * * Think of the image of the world in a convex mirror. * * * Now Beltrami's representation of pseudospherical space in a sphere of Euclid's space is quite similar, except that the

background is not a plane as in the convex mirror, but the surface of a sphere, and that the proportion in which the images, as they approach the spherical surface contract, has a different mathematical expression."

But in reality these differences are so fundamental as to make all the difference between Euclidean and non-Euclidean; for the changed measure for distance in the mirror world is still Euclidean, parabolic, using an imaginary conic in the plane background as 'absolute' in Cayley's sense.

Thus Helmholtz reproduced the old but false theorem that in space of positive curvature two geodetic lines, if they in general cut, must necessarily cut in *two* points. He never attained the conception of single elliptic space, the type-form, but speaks only of 'spherical space of three dimensions.'

It is to be hoped that Professor Willson's book may hasten the day in America when courses in descriptive geometry and pure projective geometry, no longer confined to science schools, may be available in every college, and when there may be a more adequate realization of the power of spatial imaging as an instrument in scientific research.

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

Chapters on the Natural History of the United States. By R. W. SHUFELDT, M. D., etc. New York, Studer Bros. 1897. Pp. 480.

This volume is a collection of articles, most of which were published originally in 'Shooting and Fishing' and other periodicals, and now reappear, revised and somewhat expanded. A wide range of topics is covered—insects, crustaceans, fishes, amphibians, reptiles, birds and mammals occupy one or more chapters each, by far the larger space being given to birds. As a rule, each chapter treats some general subject, such as 'Crayfish and Crabs,' 'Gulls and their Allies,' 'The American Warblers and Sparrows,' passing the whole group in review, mentioning some of its more striking forms, and giving detailed descriptions of one or two species, with extended accounts of their habits, these latter often augmented by quotations of considerable length from various well-known authors. The anatomy of the animal under consideration is occasionally touched upon and questions of classification are frequently discussed—matters which, it may be feared, will not prove very interesting to the general reader, for whom the work is intended.

The book is illustrated with a hundred and thirty figures, many of them occupying full pages. Nearly one-half are reproductions of photographs of living animals, and are worthy of considerable study for the light they throw upon the possibilities and the difficulties in the use of photography for zoological illustration.

C. F. B.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 287TH MEETING, SATURDAY, FEBRUARY 26.

DR. E. A. DE SCHWEINITZ presented a paper on 'The Treatment of some Animal Diseases with Antitoxic Serums,' briefly reviewing the work as carried on in the Bureau of Animal Industry some years ago for the purpose of treating animals with the poisons formed by the swine plague and cholera suis germs. This work was fairly successful from an experimental standpoint, but did not seem to warrant practical use in the field on account of many difficulties which might arise. The preliminary experiments made in the Biochemic Laboratory with the serum of animals immune to cholera suis, in 1892, and again with those immune to cholera suis and swine plague germs, published in August, 1896, showed that these two diseases of swine which cause such enormous losses to the farmers of the country could be cured in experimental animals. Accordingly, practical field experiments were tried, which demonstrated that sick herds could be greatly benefited and a large portion of the animals cured if they were given injections of sufficiently strong serum that had been carefully prepared for the purpose of curing the two diseases above mentioned. The expense of this method if legitimately conducted is comparatively small, and it is possible to prepare a serum that would have the desired curative effect which should not cost more than 10 cents for each injected animal. Further practical experiments on a more extensive scale will be conducted, but the

results so far indicate that antitoxic serums, which have been of such inestimable value to the health of man in many diseases, may prove very valuable to the farmers.

Professor O. P. Hay spoke on 'The Protospondyli and Ætheospondyli of A. S. Woodward,' stating that the suborders of Mr. Woodward were not natural and that the families Semionotidæ and Pycnodontidæ should be removed from the group typified by *Amia* and placed among the families whose modern representative is *Lepisosteus*.

Dr. Theo. Gill spoke on 'The Classification of Astacoidean Crustaceans,' saying that the crayfish are of more than ordinary interest because since the appearance of Huxley's 'Introduction to the Study of Zoology' they have been largely used in laboratories for purposes of instruction. In connection with a university course, the speaker had occasion to investigate the group, and found differences of opinion among recent authors respecting various questions. Such are the limits of the superfamily, the limits of the families, the gradation of the families, or which is the most specialized, the origin of the different types, the nomenclature of the genera and of the families and superfamily. He had been led by his studies to results somewhat different from others in the aggregate, but agreed in almost all points with some one of the previous investigators. In his opinion the name *Astacoidea* of Dana may be retained as the name of a superfamily containing four families, which may be called *Eryonidæ*, *Homaridæ*, *Parastacidæ* and *Astacidæ*. Reasons for the adoption of the families, as well as for their sequence and nomenclature, were given. Special emphasis was placed on the development and degrees of approximation of the generative organs as indications of divergence and specialization.

F. A. Lucas,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON, FEBRUARY 23, 1898.

One of the communications was by Mr. H. W. Turner, U. S. Geological Survey, and was on the 'Origin of Yosemite Valley.'

The rocks surrounding the Yosemite Valley are chiefly granites and gneisses. These rocks, originally all massive, have been subjected to stresses resulting in the development of sets of partings, two of which are vertical, crossing each other at approximately right angles; another set horizontal, and two or more diagonal sets. At no place are all of these partings, which would be called by some a joint structure, equally developed. It is the rule that in the neighborhood of the valley a set of vertical partings running nearly parallel with the valley are most prominently developed. These are seen particularly well on a spur at the west end of the valley, at Cathedral Spires and at Sentinel Rock. What is probably another set extends up the spur east of the valley, passing just north of the Half Dome. At Yosemite Falls likewise a set of nearly vertical partings may be noted, although these are not readily seen from the valley below. Nearly all the topographic forms about the valley are dominated by these structure planes. To the vertical partings are due the vertical walls, and to the diagonal partings some of the inclined surfaces, like those of the Three Brothers. The domes of the valley are considered as due to exfoliation by weathering. Such exfoliation only takes place where a mass of the granite is not divided by joint structure. The vertical north face of the Half Dome is believed to be due to the vertical partings, the granite having broken off in slabs from time to time as the base was undermined by erosion, while the mass constituting the Half Dome, being comparatively free from partings, has become rounded by exfoliation of successive shells of weathered rock.

The Yosemite Valley is regarded as a widened portion of a river canyon, the upper portion of which is now occupied by Tenaya Creek. It is believed that river erosion had excavated a canyon here before the valley was occupied by a glacier. The small amount of débris in the valley along the base of the vertical cliffs is due to all the taleus having been removed by glacial ice. It should be remembered, however, that the exact form of the rock bottom of the valley is not known, inasmuch as the glacier, when retreating, left moraines at the west side of the valley which acted as a barrier, causing a temporary lake to form. The final result of this

was the deposit of a large amount of sediment, chiefly gravel and sand, which forms the present floor of the valley.

The other communication was on the Tertiary of South Dakota and Nebraska, by Mr. N. H. Darton, U. S. Geological Survey.

This communication, which was illustrated by lantern slides, set forth the results of recent stratigraphic studies covering Nebraska west of the 103d meridian and the adjacent area in the Big Bad Lands of South Dakota. Several great overlaps and unconformities were discovered which explain variations in fauna of the Neocene formations in different portions of the region. The White River series was found to be overlain southward in Pine Ridge and the Platte Valley by one, and in places two, formations which had hitherto not been differentiated. New light was obtained on relations of the Loup Fork beds of the northwestern Nebraska region to the Tertiary grit, etc., of the Kansas region. Account was given of the great sheets of volcanic ash interbedded at five horizons from the White River formation to early Pleistocene. The Dæmonelix beds were studied and much attention given to the underground water resources.

WM. F. MORSELL.

TORREY BOTANICAL CLUB, JANUARY 26, 1898.

THE first paper, 'New Sapindaceæ from South America,' was by Dr. Radlkofer, of Munich, and presented by Professor Burgess. It contained descriptions of *Urvillea*, *Serjania* and *Paullinia*, soon to be printed in the *Bulletin*. Their type specimens were exhibited, forming part of a collection made by Dr. Rusby in Bolivia.

The second paper, by Dr. J. K. Small, 'The genus *Bumelia* in the Southern States,' described the distinctive characters of 13 species, 5 of which had been before recognized. Discussion on specific limitation followed, President Brown, Dr. Britton, Dr. T. F. Allen, Dr. Small, Dr. Underwood, Professor Lloyd and the Secretary participating.

Dr. Britton spoke of cultivation in the Botanic Garden at Bronx Park as having already settled some questions of specific limits. Mr. Nash has, in this way, proved *Potentilla Canadensis* and *P. simplex* to be distinct, also the European *Pyrola rotundifolia* and the American species long so known.

The third paper was by Dr. N. L. Britton, 'Remarks on some species of *Senecio*,' with exhibition and discussion of illustrative specimens, and of several new species, soon to be printed. One species from White Sulphur Springs is one of three plants on Kate's Mountain, which find their nearest relatives on the Rockies, 1500 miles distant.

Discussion followed on the respective value to be assigned to different characters. Dr. Britton held that absence of rays is an uncertain distinction in *Senecio* and that involucral characters are more permanent. The Secretary remarked on the failure of achene characters in *Aster*, and Dr. Britton upon the same in *Helianthus*. Professor Lloyd remarking that *a priori* we should expect to find greatest variation in organs like leaves which are in direct contact with their environment, Dr. Britton said that though leaves vary much in form they vary but little in assimilation-tissues, their special character.

EDWARD S. BURGESS,
Secretary.

ENGELMANN BOTANICAL CLUB.

THE Club met at the Shaw School of Botany, February 10th, seventeen members present. Mr. Colton Russell read a paper on the topography and ecology of the Archean region of Missouri, and briefly described the different floral districts. He showed what an interesting field is here presented for the study of plants in relation to soil, humidity, exposure, etc. This region, sometimes picturesquely called the Missouri Island, is an ancient granitic outcrop in the southeastern part of the State, and contains rather extended sandstone areas. It is surrounded by a vast extent of limestone country. He exhibited specimens of rare and local plants, also specimens of rocks and soil. Five new members were elected.

The Club met again on February 24th, thirty-two members present. Mr. J. B. S. Norton read some biographical notes on the late Dr. J. F. Joor, whose herbarium recently became the property of the Missouri Botanical Garden.

Dr. Joor was an enthusiastic collector of Southern plants. Owing to ill-health he was rather reserved, but his zeal for his chosen pursuit knew no bounds. His collections were made chiefly about New Orleans, southern Louisiana and eastern Texas. Mr. H. von Schrenk exhibited some specimens of *Smilax bona-nox* covered with numerous hairs. These hairs seem to occur on this plant only in dry exposed places. He spoke briefly on the spines of *Xanthoxylum clavi-Hercules*, which at first grow on the epidermis of the stem, but are pushed out as the twig grows older by a layer of cork. A new cork layer is added each year, larger in area than the preceding one, so that at the end of a period of years the spine stands at the apex of a cork pyramid an inch or more in height. Mr. Walter Retzer spoke on some features of tricotyledonous plants, exhibiting seedlings of the following plants with three cotyledons: *Trifolium repens, Celosia cristata, Cosmos bipinnatus, Ilex Dahoon, Antirrhinum major, Verbena hybrida, Dianthus chinensis.* Four new members were elected.

HERMANN VON SCHRENK,
Secretary.

SCIENTIFIC JOURNALS.

THE *American Journal of Science* for March contains a short but important paper by Professor Michelson describing a spectroscope without prisms or gratings. With only twenty elements consisting of optical glass 5 mm. thick, the resolving power would be 100,000, which is about that of the best gratings. Professor Michelson has tried the experiment with seven elements and found that the Zeeman effect could be readily observed. The number contains a paper by Mr. N. H. Darton on 'Geothermal data from deep Artesian Wells of Dakota,' read at the recent meeting of the Geological Society of America, and an abstract, entitled 'Auriferous Conglomerate of the Transvaal,' by Mr. G. F. Becker of his paper published in the last report of the U. S. Geological Survey.

THE March number of *Appleton's Popular Science Monthly* contains as frontispiece a portrait of Lord Lister, which is accompanied by a sketch of his life and work. The important series of Lowell Institute lectures on the Racial Geography of Europe, by Dr. Wm. Z. Ripley, is completed in the present number with the 14th part entitled 'Urban Problems.' The first article is an illustrated account of 'The African Sahara by Professor Angelo Heilprin.' The number also contains an account of the St. Louis Academy of Natural Sciences, by Professor Frederick Starr, and several other articles of interest.

IN addition to the usual articles on Arctic exploration, birds and the Klondike, the popular magazines contain several contributions of interest to men of science. Under the title 'A National Seminary of Learning,' Dr. W J McGee reviews in *Harper's* the work of the scientific institutions and bureaus of Washington as realizing, to a great extent, Washington's wish for a great national university, and in the same journal Mr. H. S. Williams continues his series of articles on science, reviewing anatomy and physiology. The second of a series of articles in the *Cosmopolitan* on the choice of a profession is by Professor E. S. Holden, and reviews the opportunities offered by science to young men. In this connection may also be mentioned an article in the *Homiletic Review* on 'The Value of a Scientific Education for the Pulpit.'

THE *School Science Review*, a monthly journal 'devoted to science for the teachers in the common schools,' has begun publication at Granville, Ohio, succeeding *The Examiner*, of which two volumes had previously been published. The journal is edited by Mr. W. W. Stockberger, of the Doane Academy, Granville, assisted by Messrs. E. E. Richards and C. S. Hoskinson. Such journals indicate a growing interest in the study of science in the schools, and have a mission of increasing importance to perform.

HERR S. KARGER, Berlin, announces the publication, beginning with the present year, of a *Jahresbericht über die Leistungen und Fortschritte auf dem Gebeite der Neurologie und Psychiatrie*, edited by Drs. Mendel, Flatau and Jacobsohn, with the cooperation of a number of specialists.

A *Dermatologisches Centralblatt*, on the usual lines of German Centralblätter, has begun publication from the house of Veit & Comp. Leipzig. It is edited by Dr. Max Joseph, Berlin.

SCIENCE

FRIDAY, MARCH 18, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE DEVELOPMENT OF ELECTRICAL SCIENCE. *

I.

IN a brief discourse on the development of electrical science little time can be given to the early history of the subject. This part is more or less familiar to all the members of the Academy, and hence it may be passed over by only such brief reference as may serve to recall to mind the more important of the early discoveries. The early Greeks have recorded some elementary phenomena now known to be electric, and it is probable that such knowledge was not uncommon, though little noticed. It is only in comparatively recent times that scientific research has taken the place of superstition and attempts have been made to classify and find reasons for the existence of all natural phenomena.

Beginning with the 17th century, probably the first investigator worthy of notice in this subject was Gilbert, of Colchester, who published his work entitled 'De Magnete' in 1600. Gilbert made systematic experiments and showed that the property of attracting light bodies could be given to a large number of substances by friction. He also showed that the success of the experiment depended largely upon the dryness of the body. These experiments gave rise

* Address of the President delivered before the annual meeting of the Indiana Academy of Sciences on December 29, 1897.

to the classification of substances as electrics and non-electrics. The true significance of Gilbert's observations as to the effect of moisture was not appreciated for a long time. Gilbert's list of electrics was added to by a number of other observers, prominent among whom were Boyle and Newton. The fact that light and sound accompany electric excitation was called attention to by Otto von Guericke, who also showed that a light body after being brought into contact with an electrified body was repelled by it.

Coming now to the 18th century, we find Hawkesbee in 1707 and Wall in 1708 speculating on the similarity of the electric spark and lightning. Then comes one of the most prominent experimenters of this century—Stephen Gray—who began to publish in 1720 and who in 1729 found that certain substances would not convey the charge of an electrified body to a distance. These experiments were the first to introduce the distinction between conductors and non-conductors, and, of course, very soon served to explain the reason why certain substances could not be electrified by friction when held in the hand. Gray also made the important discovery that the charge of an electrified body is proportional to its surface, and this was afterwards confirmed by the experiments of Le Monnier. Many of Gray's experiments were repeated and extended by Du Fay, who found that all bodies could be electrified by friction if they were held by an insulatory substance. Then came the improvements of the electric machine by Boze and Winckler; the firing of inflammatory substances, such as alcohol, by means of the electric spark by Ludolph, Gordon, Miles, Franklin and others. About this time (1745) the properties of the Leyden jar were discovered by Kleist, Cuneus and Muschenbroeck, and a few years later it was given practically its present form by Sir William Watson. Then follows one of the periods of exceptional activity in electrical research. A party of the Royal Society, with Watson as chief operator, made a series of experiments having for their object the determination of the distance to which electrical excitation could be conveyed and the time it takes in transit. They found among other things that several persons at a distance apart might feel the electric shock if they formed part of a circuit between the electrified body and a conductor such as the earth; also that the earth could be used to complete the circuit in Leyden jar discharges. They concluded that when two observers connected by a conductor, and at, say, two miles apart, obtained a shock by one touching the inside coating of a Leyden jar and the other the earth the electric circuit was four miles long, that is, the earth acted as a return conductor. They also concluded that the transmission was practically instantaneous. Watson had ideas as to electric fluids similar to those which were afterwards systematically worked out by Franklin. A great many curious and interesting experiments were made about this time, as, for example, the influence of electrification on the flow of water through capillary tubes as discovered by Boyle, the experiments of Mowbray on the effect of electrification on vegetation, and those of the Abbe Menon on the loss of weight of animals when they were kept electrified for a considerable time.

The effect of electrification on the flow of water has received considerable attention from eminent authorities in recent years, and that of the effect of electrification on the growth and composition of vegetable is at present attracting attention in the form of systematic investigation.

The contributions of Franklin are by far the most important which mark the middle portion of the 18th century. Franklin's experiments were begun about the middle of the year 1747, and seem to have been in-

spired by the receipt of a Leyden jar from a friend, Wm. Collinson, of London. He propounded the theory of positive and negative fluids, which has lately, in a modified form, been brought so prominently into notice again by the writings of Lodge, and he made an investigation of the principle of the Leyden jar, but the most important of his researches relate to the identification of electricity and lightning. The probable identity of the two phenomena had been hinted at, as we have seen, by several observers, but Franklin went systematically to work to test the hypothesis. Under date of November 7, 1749, the following passage is found in his note-book: "Electric fluid agrees with lightning in these particulars: (1) Giving light. (2) Color of the light. (3) Crooked direction. (4) Swift motion. (5) Being conducted by metals. (6) Crack or noise in exploding. (7) Subsisting in water or ice. (8) Rending bodies in passing through. (9) Destroying animals. (10) Melting metals. (11) Firing inflammable substances. (12) Sulphureous smell. The electric fluid is attracted by points; we do not know whether this property is in lightning. But since they agree in all the particulars wherein we can already compare them, is it not probable that they agree likewise in this? Let the experiment be made." The hypothesis was elaborated and sent to his friend Collinson, who communicated it to the Royal Society. This Society rather ridiculed Franklin's ideas at first, but his paper was published in London and also in France, and attracted considerable attention.

The experiment was first made in France by M. d' Alibard, at Marli, on May 10, 1752, and it was repeated shortly afterwards by M. de Lor, in Paris. The results of what were called the Philadelphia experiments were communicated to the Royal Society and caused quite a stir in scientific circles. It is right to say, with regard to the Royal Society, that Franklin's claims to scientific recognition were championed by Sir William Watson, and were fully endorsed by the Society by his election to a Fellowship and the award of the Copley Medal, together with the free donation of the Society's Transactions during his life.

Franklin's own experiments with kites are well known, as is also the method of protecting buildings from lightning which was introduced by him and is still very widely used, although it has been greatly abused by the lightning-rod man.

During the next decade Canton discovered the now commonly known difference between vitreous and resinous electricity. Beccaria experimented on the conducting power of water. Symmer made a number of interesting experiments on the electrification of different kinds of fabrics by friction, and propounded a theory of two electric fluids. Contemporaneous with these were a number of other experimenters who added to the stock of knowledge of this class of phenomena.

The experiments of Aepinus and others on the pyroelectric properties of tourmaline now began to attract attention. The experiments of the Abbé Haüy are perhaps the most important in this connection at this stage of the subject. He found the polar properties of the crystal and showed that similar properties were possessed by a number of other crystals. Aepinus made experiments in other branches of electricity, but he is chiefly noted for his ingenious single-fluid theory of electricity.

Between the years 1770 and 1780 the electrical organs of the torpedo were one of the principal topics of discussion. The experiments of Walsh and Ingenhousz were the first to definitely settle the character of the peculiar power of the fish.

The experiments of Cavendish belong to this period and were remarkable as being quantitative in their character. Consider-

ing the means at his command, the measurements made by this experimenter of the relative conducting powers of various substances must always excite admiration. Cavendish also proved the composition of water by causing different proportions of oxygen and hydrogen to unite by means of the electric spark.

We now come to the classical experiments of Coulomb, who established the law of the variation of the electric force with distance to be that of the inverse square, a law which had previously been inferred from experiments on spheres by Dr. Robinson, who, however, did not publish his results. Coulomb made an elaborate series of experiments on the distribution of electricity over charged conductors as influenced by shape and the proximity of other charged bodies. His theoretical and experimental work formed the basis of the mathematical theory as developed shortly afterwards by Laplace, Biot and Poisson, the work of the latter being particularly important.

Toward the end of the 18th century were made the important researches of Laplace, Lavoisier and Volta, and of Sausure in the electricity produced by evaporation and combustion. This is a subject destined to figure prominently again in the future, and in its rise there is in all probability involved the rapid decline in the importance of the steam engine. I should not be surprised if many of those present should live to see the steam engine practically a thing of the past.

In the 18th century also we must assign the discovery of Galvanic electricity, as the famous frog experiments were made in 1790. Practically no development was made, however, until Volta's work attracted the attention of the scientific world.

At the beginning of the 19th Century, then, we find the subjects of greatest interest were the discoveries of Volta and the invention of the voltaic pile. There followed almost immediately the discovery by Nicholson and Carlisle of the decomposition of water by the voltaic current. This discovery was followed a few years later by those of Sir Humphry Davy on the decomposition of the alkalies and the separation of metallic sodium and potassium. Thus the subject of electrolysis was fairly launched, and what it has grown to be we will see later.

Can there be some inter-relation between electricity and magnetism was now the query? The first positive answer seems to have been given by Romagnesi in a work published in 1805, but little or no notice appears to have been taken of this. Certainly no progress was made in the subject till 1820, when Oersted made his famous experiment before his class. By that experiment he proved that a wire carrying an electric current will, when properly placed, deflect a magnetic needle. The subject was almost immediately taken up by Ampere, and in a few months many of the important consequences which Oersted's discovery involved were developed. Ampere's work on the action of currents on currents and on magnets is classical and is still treated as part of the fundamental basis for the theory of electrodynamics. An account of his work may, therefore, be found in almost any of the numerous text-books on electricity. The conclusions reached by Ampere were confirmed by Weber by a series of much more refined experiments. To Weber also we owe improvements in galvanometers. The same year marks the discoveries by Arago that a current can not only deflect a magnet, but that it is capable of producing one by magnetizing steel needles.

The further discovery was made four years later by Sturgeon that soft iron although incapable of making a strong permanent magnet is yet much more susceptible to temporary magnetization by the electric current. Arago also made about

this time the important discovery that if a needle be suspended above a copper disc and the disc rotated the needle will be dragged round with the disc. This was not explained for some years, but seems to be the first discovery of induced currents.

These experiments mark the discovery of electro-magnetism, and began one of the most important eras in electrical discovery, the work which has been participated in by many eminent authorities. Among the many advances may be mentioned the experiments of Henry on the relative effects of different windings on the strength of an electro-magnet. He deduced the fact that the magnetizing action might be increased either by increasing the number of windings, the current remaining the same, or by increasing the current, the winding remaining the same. He pointed out the application of this to intensity and quantity arrangements of the battery, and also the importance of the intensity winding for the transmission of magnetizing power to a distance, as in telegraphy. The increased effect due to increasing the number of windings on the coil of a galvanoscope had been previously pointed out by Schweigger, and the discovery is embodied in Schweigger's galvanoscope.

In 1821 Faraday began his researches and many important discoveries were made by him. The main guiding idea in Faraday's work was the possibility of obtaining electricity from magnetism and in general the discovery of the inter-relation between the two. In this connection Arago's discovery of the rotation of a copper disc by the rotation of a magnet above it is of great importance, because, among other things, Faraday set himself to explain this. The result was the discovery of the commutatorless dynamo, or Faraday disc. In view of modern developments, probably the most important of Faraday's discoveries was that of the production of a current in a circuit when a current is either established or varied in strength in an adjacent circuit. This was followed by the discovery that relative motion of two circuits, one of which carried a current produced a current in the other, and that the motion of a magnet in the neighborhood of a circuit produced a current in the circuit. Another important discovery by Faraday was that of the quantitative laws which govern electrolytic decomposition, thus giving us our electrochemical equivalents.

At this time Lenz was led by experiment to the discovery of his celebrated law of induction, namely, that the current produced always in turn produces forces tending to oppose the change. For example, if a current be induced in a coil by bringing a magnet towards it the mutual action between the magnet and the current is to oppose the magnet's approach. This is important when looked at from the point of view of the conservation of energy or as an argument against perpetual motion. Lenz's law is, of course, when the actions are properly understood, a consequence of Newton's third law of motion.

Discoveries similar to those of Faraday as to induced currents were made almost simultaneously by Henry in this country. We have in the discoveries of Faraday and Henry the fundamental information required for nearly the whole of our recent developments in dynamo-electric generators and electric motors, but it was reserved for the next generation to develop them. This development we owe in no small degree to the spendid exposition of Faraday's discoveries and their consequences contained in Maxwell's book on electricity and magnetism.

Going back for a moment to 1822 we have to notice another important discovery, namely, the thermoelectric couple by Seebeck. There followed almost immediately the important experiment of Cumming, who

showed that the thermoelectric order of the metals is not the same at all temperatures.

The next important discovery in thermoelectricity was that of Peltier, of the heat generated at the junction of two metals when a current is forced across it against the e. m. f. of the junction. In later years we have the classic researches of Thomson (Kelvin), who added thermoelectric convection and the specific heat of electricity and gave the thermoelectric diagram method of representing results. This method was afterwards used and extended by Tait, who added a good deal to our knowledge of thermoelectric data. Among the large number of others who have worked in this field we may mention Becquerel, Magnus, Matthieson, Leroux and Avenarius. Thermoelectric batteries of considerable power have been made by Clamond and others.

In 1827 the celebrated law giving the relation between e. m. f. resistance and current was published by Ohm in a paper on the mathematical theory of the galvanic circuit. The theory has been sometimes criticised, but there seems to be absolute certainty that the law is almost exact, and it has proved of the greatest importance in the further development of the subject of electric measurements.

The subject had about the middle of the century reached a stage in which it was possible to develop almost completely the mathematical theory as we now have it. Most of the work since Faraday's time has been directed towards quantitative measurements and the furnishing of exact data to answer questions as to how much in various cases. F. E. Neumann discovered what he called the potential function (now called the coefficient of self and mutual induction) of one current on another and on itself and succeeded in giving a theory of induction which was in accordance with the experimental laws. The laws were afterwards experimentally verified by Weber. In 1849 the experiments of Kirchoff on the absolute value of the current induced in one circuit by another, and in the same year Edlund's experiments on self and mutual induction, are important. In 1851 Helmholtz gave a mathematical theory of this part of the subject, which he supplemented with an experimental verification.

One of the most important of the series of experiments made by Henry was on the oscillatory character of the discharge from a Leyden jar. This he discovered from the effect of the discharge on a steel needle surrounded by a coil, through which the current was made to pass. The results of these experiments were communicated to the A. A. A. S. in 1850, but he knew of the effect much earlier, certainly in 1841. Previously the anomalous behavior of the discharge of a jar when used to magnetize steel needles had been noticed, but was attributed, as I believe, to some peculiarity of the steel. Henry was the first to appreciate the true reason, although he could hardly at that time be expected to see the great importance of his discovery.

Helmholtz, in 1847, suggests that the discharge of Leyden jars may be of the nature of a backward and forward movement. There is a curious parallelism in the work of several investigators about this time, and particularly in that of Hemholtz and Thomson. In the *Philosohphical Magazine* for 1855 there is paper by Professor W. Thomson (Kelvin) in which the theory of the discharge of a Leyden jar is discussed and the prediction made that under certain specified conditions the discharge must be oscillatory. A number of similar papers, going back to 1848, treat of similar subjects. Henry's results do not appear to have become generally known, and we find the verification of Thomson's prediction in 1857 by Feddersen. A number of other physicists have investigated the subject, the work of Schiller being of particular

value. The recent applications will be referred to later.

The mathematical theory of electrostatics and magnetism was greatly extended about this time by Thomson and others, and received its most complete statement at the hands of Maxwell in his papers read before the Royal Society and in his book, published in 1873, but still the standard of reference. Very little has since been discovered which was not foreshadowed by Maxwell's theory or contained in his equations, which have been found general enough to cover almost everything, although experiment has generally been necessary to suggest the consequences of the theory.

The practical applications of electricity have played a most important part in the development of the subject during the last sixty years. Indeed, a great part of the work of these years has had some practical application in view. One of the first of these practical applications was that of telegraphy.

The telegraph, being one of the earliest of the practical developments, naturally had a great effect in stimulating the advance in knowledge of electricity, and hence I give a somewhat fuller sketch of the early history, that space will permit for the later applications.

The discovery of Stephen Gray, in 1829, that the electrical influence could be conveyed to a distance by means of an insulated wire, is probably the first of direct influence in connection with telegraphy. As a result of this discovery and the investigations which followed it, a considerable number of proposals were made as to the use of the electrical force for the transmission of intelligence. The first of these of which I have found any record was made in 1753 by Charles Morrison, a Scotchman, and then followed other proposals for electrostatic telegraphs by Bozolus in 1767, by Le Sage in 1774, by Lomond in 1787, by Betancourt in the same year, by Reizen in 1794, by Cavalla in 1795 and by Ronalds in 1816.

The discovery of voltaic electricity, and most directly the discovery of Nicholson and Carlisle of electrolysis gave rise to another group of proposals for the application of this discovery to the production of telegraphy. Among those may be mentioned that of Sömmering in 1809, of Coxe in 1810 and of Sharpe in 1813. In more recent years, of course, the same application appears in the chemical telegraphs, some of which are capable of giving very satisfactory results and great speed.

The discovery which had the greatest influence on the development of telegraphy was that of Oersted, supplemented by the work of Schweigger and Ampere. Ampere proposed a multiple-wire telegraph with galvanoscope indicators in 1820, and a modification was constructed by Ritchie. A single-circuit telegraph of this character was invented by Tribaoillet, but didn't come into use. In 1832 Schilling's five-needle telegraph appeared, and he, also, used a single-needle instrument, but his early death stopped further progress. In 1833 Schilling's telegraph was developed, to some extent, by Gauss and Weber, who used it for experimental purposes. The following quotation, referring to Gauss and Weber's telegraph, from *Poggendorf's Annalen*, is of considerable historical interest:

"There is, in connection with these arrangements, a great and until now in its way novel project, for which we are indebted to Professor Weber. This gentlemen erected, during the past year, a double-wire line over the houses of the town (Göttingen), from the Physical Cabinet to the Observatory, and lately a continuation from the latter building to the Magnetic Observatory. Thus, an immense galvanic chain is formed, in which the galvanic current, the two multipliers at the ends being included, has to travel a distance of nearly

9,000 (Prussian) feet. The line wire is mostly of copper, of that known as 'No. 3,' of which one metre weighs eight grammes. The wire of the multipliers in the Magnetic Observatory is of copper, 'No. 14,' silvered, and of which one metre weighs 2.6 grammes. This arrangement promises to offer opportunities for a number of interesting experiments. We regard, not without admiration, how a single pair of plates, brought into contact at the farther end, instantaneously communicate a movement to the magnetic bar, which is deflected at once for over a thousand divisions of the scale," Further on in the same paper : "The ease with which the manipulator has the magnetic needle in his command, by means of the communicator, had a year ago suggested experiments of an application to telegraphic signalling, which, with whole words and even short sentences, completely succeeded. There is no doubt that it would be possible to arrange an uninterrupted telegraph communication in the same way between two places at a considerable number of miles distance from each other."

The method of producing the currents in Gauss' and Weber's experiments was an application of the important discoveries of Faraday and Henry, above referred to, in the induction of current by currents and by magnets.

On the recommendation of Gauss, this telegraph was taken up by Steinheil, who, following their example, also used induced currents. The important contributions of Steinheil were the discovery of the earth return circuit, the invention of a telegraphic alphabet and a recording telegraph. Steinheil contributes an account of his telegraph to Sturgeon's Annals of Electricity in which the relative merits of scopic, recording and acoustic telegraph are discussed, and the advantages, which experience has since brought into prominence, of the acoustic form are pointed out.

Schiller's telegraph was exhibited at a meeting of German naturalists held at Bonn in 1835, and was there seen by Professor Muncke, of Heidelberg, who, after his return to Heidelberg, made models of the telegraph and exhibited them in his classroom. These models were seen by Cooke in the early part of 1836, and gave him the idea of introducing the electric telegraph in England. Cooke afterward became associated with Wheatstone, and a large number of ingenious arrangements for telegraphing was the result. Many of the later developments by Wheatstone are still in use and are hard to beat.

Steinheil appears to have been anticipated in the idea of making the telegraph self-recording by Morse, who, according to evidence brought forward by himself, thought out some arrangements as early as 1832. Exactly what Morse's first ideas were seems somewhat doubtful, and he did nothing till 1835, when he made a rough model of an electro-magnetic recording telegraph. Morse's mechanical arrangements were of little merit, and his alphabet and method of interpretation by a dictionary were clumsy and inconvenient. The chief point of interest in connection with the early history of the Morse telegraph was the proposal to make use of Sturgeon's discovery of electro-magnetism of soft iron. Morse, however, seems to have known practically nothing of the subject except that iron could be magnetized by a current, and in consulting his colleague, Dr. Gale, he was unwittingly led to use the discoveries of Henry, who had previously practically solved the whole problem. Much of the subsequent improvement in the mechanical arrangements were due to Vail, who became associated with Morse, and the Morse code as we now know it was almost, if not entirely, worked out by Vail. Considerable dispute and some litigation arose over Morse's claims, but that is outside our

present subject. There is no doubt that the electric telegraph was a slow-growth invention, with a view to pecuniary and other advantage, being ever ready to lay hold of each scientific discovery and try to turn it to account. The question who first conceived the idea can never be satisfactorily answered.

After 1840 there is little to record of a purely electrical character bearing only on telegraphy, but there have been many very ingenious mechanical contrivances introduced for recording signals, for reproducing pictures and handwriting and for printing, for duplexing, quadruplexing and multiplexing telegraph lines, for increasing the rate of signaling and in many ways increasing the expedition with which messages can be sent. Of course, the success of many of these contrivances, and even their invention, depended upon an increased knowledge of the laws of electricity and magnetism. For example, effective duplexing, quadruplexing, etc., depends on a proper understanding of the electrostatic capacity of the line, and this was not understood properly until the mathematical investigations of Thomson and others cleared the matter. For the impetus towards discovery in this direction again we are largely indebted to telegraphy, for much of that class of work was suggested by the difficulties encountered in signalling through long submarine cables.

The invention of the telephone is fast becoming ancient history, and yet it will always mark one of the greatest of the useful applications of electricity. It does not call for more than a passing remark here, because electro-magnetically it is all in Faraday's and Henry's papers.

The radiophone should be mentioned because it marks the application of the discovery, by May and Smith, of the effect of light on the resistance of selenium. This effect has since been found in the case of a large number of other substances, but it is still an interesting field for research. A number of experiments on this subject have been associated with attempts to make things visible at a distance. No doubt it will ultimately be possible not only to talk to a distant party, but also to see the party talked to, and thus, as it were, look the party with whom you are conversing in the eye.

THOMAS GRAY.

ROSE POLYTECHNIC INSTITUTE.

(To be concluded.)

THE PROVINCE AND PROBLEMS OF PLANT PHYSIOLOGY.*

THE exploitation and survey of the flora of our continent is a task of such tremendous magnitude that it has consumed the greater portion of the energy of American botanists until within a few years of the present time. The constantly increasing number of workers attracted to the subject has made possible not only a more thorough organization of the interests of taxonomic botany, but has also permitted a great deal of attention to questions of general morphology and cytology. Within the last decade an awakening interest has been shown in subjects in the physiology of plants. This interest has been manifested by the introduction of physiological matter in the text-books on botany, by the organization of courses of instruction in this branch in some of the more prominent colleges and universities, and by the accomplishment of investigations of more or less importance.

Any subject is liable to misconception and misapprehension during the earlier stages of its introduction into any country, and plant-physiology in America is no exception to the probability.

A misapprehension of a subject is likely to be followed by a perversion of the facilities devoted to it, the neglect of its

* Read before the Minnesota Academy of Science, December 30, 1897.

real and intrinsic phases, and finally, by the suppression of needed investigation in regions of the subject less fully developed. Furthermore, the distortion of the true nature of any branch of biological science is a misfortune which is bound to confuse thought and retard the progress of research. Misconceptions as to the true nature of a subject, on the part of workers engaged in it, are all the more dangerous since their expressions have the form and force of 'authority.'

A review of the courses of study, general addresses and recent publications dealing with the nature and limits of physiology, presented by American botanists is not at all reassuring. Many botanists harbor the preposterous opinion that the chief work in this subject has been accomplished in the thirty years in which active and continuous investigation within its limits have been in progress in the laboratories of the world. The persons in charge of botany in a number of institutions, in response to the demand for instruction in this branch, have labeled a course of section-cutting and reference reading 'plant-physiology,' and give the student no opportunity to acquire a knowledge of plants by actual experimental methods. If rarely he is afforded the opportunity to deal with the living plant under natural conditions it is to repeat some classic demonstration with a piece of stock apparatus to 'confirm' the results detailed in a text-book. The worst misapprehension of the subject is likely to occur in pure lecture courses based upon the text and reference books by 'readers' who have no part or interest in current investigations. Such courses are necessarily devoid of even the classic demonstrations, and the didactic character of the work quite naturally leads the student to the opinion that the subject is a closed one, and that the principles retailed him are not likely to be disturbed by future happenings.

That this state of affairs is by no mean imaginary is to be seen by the following quotation from a recent address by Dr. George Stone, in which he says: "One institution that I have in mind has advertised for years a thorough and complete equipment for work in vegetable physiology, and yet this same institution has scarcely had a single piece of purely physiological apparatus in its outfit in the whole time. The institution I refer to by no means stands alone in this matter."

The agricultural institutions have almost wholly neglected this subject of physiology, although "it is that branch of botany which has the closest relationship with all horticultural and agricultural knowledge and practice. In fact, it is the very foundation of these branches." "At the same time, we have been content to teach agricultural botany in our colleges for years, without considering it necessary to give the student any more than an elementary course in morphology, followed by flower analysis and the gathering of a herbarium, with a little histology thrown in."

The inattention to the physiological features of plant life is even more evident among experiment station workers, in the opinion of the author cited above: "There is no class of publications which shows such lack of physiological knowledge as from these, and it is shown by botanists, horticulturists and chemists as well. Their experiments frequently show that they know nothing about the functions of a plant or the factors which determine variation." The few exceptions to these statements are so well and widely known that they need no enumeration here.

In view of the above conditions, it is evident that any discussion which will bring the facts of the case into notice among American students will be of value.

Briefly stated, plant-physiology is concerned with the fundamental properties of

the protoplasm of plants, and the functions of the organisms into which it is formed. It is, therefore, a study of activities and regards structures from the standpoint of efficiency or functional value, and it includes the consideration of all reactions of growth, movement, metabolism, changes in form, irritability and other phenomena resulting from the activity of forces internal to the plant whether set in motion by internal or external stimuli. It merges into morphology in the subjects of growth and reproduction upon the one hand, and upon the other it underlies a portion of the domain of ecology, in the consideration of adaptative reactions, while with bacteriology and mycology it forms the basis of the study of pathology. Physiology and chemistry join in the consideration of the chemical activities and products of the organism, and the principles of physics are involved in the investigation of the plant machine.

It is not possible, nor would it be profitable, to separate the botanical branches too sharply in instruction or research. Some exposition of the principal functions of plants might well accompany an elementary course in morphology, and it goes without saying that a knowledge of anatomy is a prerequisite to the successful comprehension of the physiology of an organism, although some knowledge of the general principles may be obtained without it. Then again, it will often be found most profitable to extend work in physiology to include an interpretation of the more prominent adaptations, especially those of an ontogenetic character. To attempt to deal with such phases of plant life in instruction or research without a comprehension of the physiological principles involved is pure assumption.

In agricultural colleges and experiment stations the botanical problems and courses of foremost importance would be those dealing with nutrition and plant diseases. In this instance the work of the physiologist might well extend to cover almost all of the field of the pathologist.

The opinion that the main principles of physiology have been determined, and that only their minor and incidental application await delineation at the hands of the investigator, has been expressed concerning several subjects so many times in the last century that it needs no further notice at this time.

A systematic survey reveals the fact that, instead of a complete and thorough plotting of the great field of physiology, we have made here and there a few simple trails through the dense jungle of ungrouped and vaguely defined principles, and the greater part of the work is yet to be accomplished.

The fundamental problem of the constitution of living matter still confronts us. It is quite true that the chemical structure of its chief constituents, the proteids, is not yet determined, but even when this shall be known and the synthesis of this difficult group be accomplished we shall be but a step on the way, for there will still lie ahead of us the unknown physiological characters of the physical basis of life. Indeed, we may not say that we have determined even the limits of the gross anatomical existence of living matter, since there may well be stages of living matter or classes of organisms which so far have eluded our optical apparatus.

We have not yet succeeded in interpreting clearly even the cruder visible phenomena of the cell. The causes, character and purposes of cytoplasmic movement, the inter-relation of the organs of the cell, the nature of the activity of the plastids, the functional value of the nuclear constituents, and the operative relation of the protoplast to its membrane, are still open questions, while nothing but the crudest diagram of

the chemical activities of the cell is possible. The very apparent interprotoplastic threads have so far received no conclusive interpretation. Protoplasmic substance itself may wander from cell to cell, water, nutritive material, irritable or regulatory impulses may traverse these convenient pathways, but so far it has not been demonstrated that the structure in question is necessary for any of these functions.

The oldest branch of the subject is that of nutrition, and the beginnings of chemistry were made in researches upon the relation of the plant to the soil and air. The necessity and method of absorption of mineral salts and carbon dioxide is fairly understood, but the specific uses of the former and the manipulation of both classes of substances within the plant is unknown. Thus, for instance, the formation of food in the leaf from carbon dioxide and water is regarded as a photosynthesis, yet nothing is known of the process except that at an advanced stage a complex carbohydrate is produced. It is quite within the range of possibilities that the same products may result from a photosynthetic action on other carbon compounds. The composition of chlorophyll and its relation to the chloroplast are still in question. It may be lodged in interstices of the living matter or may form organic union with it. The chlorophyll may act as a converter of light into energy made available to the chloroplast, or its molecules may act as carriers in the synthesis. It is becoming even more open to doubt as to whether the activity of chlorophyll is exactly coincident with its absorption bands. Investigation in several lines must cooperate to solve this problem. The chemosynthetic activity of the nitrobacteria, and the thermosynthetic and electrosynthetic processes of other organisms, are hardly so well known.

The acquisition of nitrogen is a much vexed question, and the dawn of new investigations threatens to upset long cherished ideas as to the relation of the 'autophytes' to organic substances. The use, formation into crystals, resolution and transference of mineral substances in the plant body, is not satisfactorily explained. The balance and combined action of the several mineral elements in the soil is a matter of which we have no definite comprehension. Are the salts presented to the plant in commercial fertilizers absorbed as such and used as food, or are they subjected to synthetic activities, similar to those of the chlorophyll apparatus? Thus the presence of sodium salts in the soil is a benefit, amounting to a necessity in some instances, although this abundant element does not actually enter into the composition of protoplasm or plastic substance. The translocation, storage and formative selection of reserve material is bound up with that of fermentation, and the physiologist has progressed so far as to know that the preparation of reserve material, fluid and solid, for transportation is accomplished by means of ferments. He has isolated a few of these enzymes and has come to know that scores of others exist with action and chemical constitution unidentified. The vitalistic theory of fermentation will doubtless lurk among the residua of unexplained enzymic activities for many years to come. Indeed, the recent failure to extract a ferment from yeast gives the hypothesis a new lease of life. No doubt can exist, however, that the vital or regulatory action of the organism does play a part in these phenomena which we are not prepared to appreciate, and the secretory action concerned here and elsewhere in the plant has not received a fraction of the attention given such functions in animals.

The paucity of information of the physiologist concerning the alkaloids, glucosides, pigments and other compounds in the plant

is accented by the efforts made to explain the formation of these substances in a speculative manner upon ecological grounds.

So far as general metabolism is concerned it is to be said that the physiologist locates a substance here and there in the cell as a product of general processes, but he is incapable of more than ill-defined theories as to the course of chemical changes. It could scarcely be otherwise with the structure of the chief components of protoplasm unknown. The meager facts and abundant differences of opinion concerning the contents of resin ducts, laticiferous tissue and 'excreta' in general may well lead us to hesitate in declaring these subjects 'closed' and fixed.

The ascent of sap is a problem which has defied the combined efforts of the physicist and the physiologist for more than a century, and the results obtained by several of the most reliable investigators in the last decade have only annihilated previous hypothesis. In such manner capillarity, imbibition, the intermittent activity of protoplasm, the Jaminian chain, the lifting power of transpiration, variations in tension of enclosed gas-bubbles, and recently the tensile strength of a column of water, have each in turn held the place of importance only to give way to the inexorable logic of fact. It is generally admitted that the imbibition method proposed by Sachs is the only known method by which water *could* actually attain the summit of a tall tree, and that this method *would* furnish only a minute fraction of the amount necessary. On the other hand, it is well known that the current does not travel in the walls, but in the lumina and pits of the tracheal elements. We shall be compelled to return to the living elements and begin the investigation anew.

Time does not suffice to relate the detailed problems of growth yet unsolved, but it is becoming more and more evident that molecular features of growth are hardly at all determined, as well as the relation of this process to correlative and environmental forces.

The consideration of the effect of physiological factors, such as nutrition, light, etc., upon development and stature promises results of sweeping importance to all branches of biological science, if the few contributions which have appeared in this department may be taken as an index.

The nature of the irritability of plants, its development from the primitive reactions of protoplasm, the mechanism of reaction and transmission of stimular resultants, and the general irritable organization of the vegetal organism are yet hardly touched upon. In fact, so little understood is the sensitiveness of plants that biologists in general stand aghast at the daring of those investigators who seek to reduce it to terms comparable with those used in the description of animals.

As a specific case of incompleteness it may be mentioned that the path or conducting body for impulses in plants has not been determined in any single instance, nor has any cohesive theory as to a method of transmission ever been propounded. One may readily imagine the condition of animal-physiology if all information concerning the nervous system were wiped out of existence, and it would be known that the arm was moved by changes in form of lumps of tissue in that organ, which were set in motion when stimuli were applied to some distant organ with no apparent connection with the muscle.

The subject of reproduction has hitherto necessarily been considered from a purely morphological standpoint, although hundreds of titles of contributions upon the subject wrongly denote a physiological treatment. The time seems ripe for the physiologist to carry on researches upon the activities concerned, and some few splendid

contributions upon this phase of the subject are beginning to appear.

Lastly, it is the opinion of the writer that the physiologist has not yet entered upon the greatest task awaiting him, in the translation of the forms of activity shown by the vegetal organism into a system of general physiology, establishing a secure basis upon which coordination of accrued results may be made, a consequent better organization of the forces of attack upon waiting problems, and a more perfect articulation with all branches of biological science secured. The fact that this has not been accomplished is in part accountable for the nebulous ideas concerning the scope and status of the subject among even the botanical contingent.

In conclusion, it is to be said that it is manifestly impossible to do more than outline the developing principles which constitute the science of physiology, and suggest a few of the great gaps which remain to be filled by the efforts of future investigators. Moreover, the constant broadening of the biological sciences will demand a projection of physiological activity to cover widely diverging branches, and the interpretation of forms of activity of protoplasm yet unknown or but dimly recognized.

[Since the paper as above was prepared for the printer, Professor Loeb, in a discussion of the fundamental problems of animal physiology in this Journal (Vol. VII., p. 154, 1898), has called attention to certain facts showing that the fundamental problems in the two branches are in part identical and in part closely parallel. His estimate of the outlook, "At no time since the period following the discovery of the law of conservation of energy has the outlook for physiology appeared brighter than at present," applies to this entire department of biological science.]

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THE MOUTH-PARTS OF THE RHYNGOTA.

Two papers on the above subject have been published within the last year or two, showing that there is yet a very considerable difference of opinion as to the real homologies of the beak and four inclosed lancets which form the Hemipterous mouth. The first of the papers in point of time and very much the most important is by Dr. Richard Heymons, in the *Ent. Nachr.*, XXII., 11, for 1896; the second is by Dr. N. Leon, *Zool. Anz.*, XX., 73, March, 1897.

Dr. Leon carefully describes the beak in several species of aquatic Hemiptera and particularly two little processes from the tip of the second (third) joint, which he homologizes with the labial palpi. It is to be noted that both Leon and Heymons assume it as unquestionable that the beak is a modified labium. In support of his thesis Dr. Leon shows that by proper manipulation the original paired character of the beak becomes evident and he makes the basal joint homologous with the submentum (labial cardines); the second with the mentum (labial stipes), and the third and fourth with the glossa and paraglossa. There is some confusion in the descriptions and in *Gerris* the third joint is made mentum without explanation. The chief point of the paper, however, is in the identification of the two little lateral processes from the so-called mentum as true labial palpi.

I have seen these same processes and would be inclined to consider Dr. Leon's arguments sound, if I did not believe the fundamental assumption that the beak is labial to be incorrect.

Dr. Heymons dismisses these processes from embryological data in the conclusion that 'labial palpi, consequently, are lacking in all *Rhyngota.* The processes discovered on the beak of *Nepa* and *Belostoma* are not really such, but must be regarded as a secondary process of the third joint of the beak.

This paper by Dr. Heymons, based on embryological data, is, however, very important when carefully studied, though in some respects the assumption that the beak is the labium has led, in my opinion, to false conclusions. After disposing of Kræpelin's contention that the inner and partly united pair of lancets represent the mandibles, he states, as his first proposition, that the lateral lancets are produced from the mandibles, which are peg-like, and are withdrawn into the head. This is modified in the seventh proposition, in which it is stated that the so-called mandibles are really only the lobes of the mandibles, of which the stem has become rudimentary. Yet, further, it is limited in the eighth proposition that in the Heteroptera, finally, the mandibular stem is entirely lost and united to the anterior part of the juga; but as this leaves an unattached lancet floating about, we find in the fourth proposition that in the Heteroptera the maxillary stem is usually divided into two parts. On one, which I call lamina maxillaris, occurs the musculus protractor of the lateral lancets (mandibles). Differently stated, this means that a peg-like process is identified as a mandibular lobe whose stem disappears, which is retracted into the head, where it forms a lancet whose musculus protractor is attached to the stem of the maxilla! Now a lobed mandible is a rarity in insects, and where a lobe does occur it is either an insignificant appendage or is firmly united to the base. An absence of the lobe is the rule, everywhere; in no mandibulate is the lobe ever the only part represented. Here we are supposed to see the stem disappear and the lobe developed into an appendage attached to the maxillary stem.

If the musculus protractor is attached to part of the maxillary stem, which I have no doubt is the case, why not consider the lancet maxillary, and as lacinia, or inner lobe? This would make its attachment and association perfectly normal. Does it not seem just a little absurd to claim that such organs as the mandibles can become practically maxillary appendages?

The second proposition is that the median (inner) lancets are not made up by the maxillæ in toto, but only by their lobes, which are also peg-like and retracted into the head. The third proposition is in part that the trunk of the maxilla after the retraction of the lobes agrees in essentials with the palpi maxillaris of other insects. That is exactly what it ought to do if the lancet is the produced palpifer which I believe it to be.

Dr. Heymons proves, therefore, to my mind, that one pair of lancets is palpifer from the maxillary palpi, the other lacina from the stem of the maxilla; and this is exactly the conclusion which I reached from comparative studies. The muscles from both lancets are supplied from maxillary structures exclusively.

The fifth proposition is that 'rudimentary maxillary palpi are recognizable at the roots of the beak'. In Nepa, for instance, they are approximately onion-shaped and placed before the juga. This it seems to me indicates that the beak is also maxillary, but the ninth proposition is that the beak is derived from the third (hinder) embryonic pair of jaws. The development teaches that in the Rhyngota this pair remains simple. On the labium neither palpi nor lobes, nor any structure that may be considered such, occur. Labial palpi, consequently, are lacking in all Rhyngota.

If these embryonic processes forming the beak are really those of the labium, would not the entire absence of lobes or appendages be an unusual character? Assuming them to be, as I believe, the maxillary galea all difficulty vanishes.

The truth is, Dr. Heymons started with the conviction that he must find three em-

bryonic pairs of jaws, and he found three pairs of processes, which he so identified. Now I have shown elsewhere that the maxillæ are formed of three lateral parts, each of which may be distinct and has its own range of variation; and if we assume that the three pairs of processes observed by Dr. Heymons are all maxillary the Hemipterous mouth becomes quite clear and the attachments of the lancets and the location of the rudimentary maxillary palpi at the base of the beak is normal.

I have previously expressed my belief that the Rhyngota are not descended from a mandibulate stem and that they separated from the archetypal form before the mouth structures were definitely formed anywhere. They were emandibulata from the start, and as such are now equivalent in rank to all the other orders of insects (excluding Thrips) combined. Nor was any labial structure ever developed in this order, and all trace of such is now lost, in the adult at least.

If we study Dr. Heymons' paper in the light of these suggestions it is the most important contribution to our knowledge of the mouth parts of the Rhyngota that has recently appeared.

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*THOMAS JEFFERY PARKER.**

THOMAS JEFFERY PARKER, who died at Warrington, New Zealand, on November 7, 1897, was the eldest son of the late William Kitchen Parker, F.R.S., the world-renowned comparative osteologist. He was born in the S. W. district of London on October 17, 1850, and educated there, and his scientific training was received at the Royal School of Mines during the years 1868–1871. Leaving that institution with distinction, Parker became science master at the Bramham College, Yorkshire; and Mr. W. B. Lockwood, now assistant surgeon at Bartholomew's Hospital, London, may be named, as an anatomist who in his schoolboy days came under his influence. In 1872, at the special request of Huxley, Parker returned to London, to fill the office of demonstrator of biology at the then newly established Science College at South Kensington, now known as the Royal College of Science, London, and he held the post until his appointment, in 1880, to the professorship of biology at the University of Otago, Dunedin, New Zealand. As a teacher Parker will remain memorable in association with the development of the now universally adopted Huxleian method of laboratory instruction in biology, known and recognized throughout the world as the 'type system,' which marked the introduction of rational methods into the teaching of biological science. So earnestly did Parker enter into the task of development of this under his great master that he early became the means of effecting conspicuous changes in its methods, and he will be remembered in history as the man to whom were mainly due its progress beyond the experimental stage and the foundation, in connection with it, of the first teaching-collection of specimens and illustrative anatomical drawings based upon it—the prototype of all since established in various parts of the world.

Among Parker's published works there stands conspicuous his 'Zootomy,' a didactic laboratory treatise, and his 'Lessons in Elementary Biology,' now translated into German, a book for the study and the fireside. Both take high rank among scientific manuals in the English language and both were the direct outcome of his connection with Huxley and his educational work, and the last-named takes rank as the most important treatise for the elementary student that has appeared since

*From the *Anatomischer Anzeiger*.

Huxley and Martin's epoch-making 'Practical Instruction in Elementary Biology.' To read this book, and a charming biography of his father which Parker published in 1893, is to realize the warmth and affection of his nature, the strength of his character, the breadth of his attainments as a philosophic teacher and his command of literary style. In these and all respects Parker's was a charming character. As a companion he was loyal and affectionate, as a worker painstaking and reliable, a friend of youth, utterly destitute of ostentation and false pride, withal an exemplary man; and among those who during the period of his association with Huxley and his great work as a teacher came under his charge and benefited by his example may be mentioned F. E. Beddard, Angelo Heilprin, H. F. Osborn, W. B. Scott and Oldfield Thomas, among well-known zoologists and anatomists.

As an investigator Parker published some forty odd papers and monographs, the best known of which are those dealing with the 'Structure and Development of Apteryx' and the 'Cranial Osteology, Classification and Phylogeny of the Dinorithidæ,' sufficient in themselves to have made him famous. On settling down in New Zealand Parker early published a short paper on a new species of Holothurian (*Chirodotes Dunediensis*), as it were in anticipation of the later resolve by him and his colleagues, who were during the early 80's appointed to the Australasian professorships of biology, to preferably investigate their indigenous fauna, leaving the refinements of histology and the like for those at home. The results of the combined labors of these men are now monumental. Their work is now saving from oblivion a knowledge of things rapidly passing away, and there will ever remain memorably associated with the desire to create a sustained interest in a series of short 'Notes from the Otago University Museum,' which Parker during the seventeen years he was in New Zealand contributed to the pages of *Nature*, and of 'Studies in Biology for New Zealand Students,' which he instituted and which his pupils and co-workers maintained. Apart from this special interest, as involving the investigation of the Australasian fauna, Parker's published works cover a wide field. Vertebrates and Invertebrates alike came under examination, and in his series of papers on the anatomy of the Crayfishes, which culminated in a contribution to the 'Macleay Memorial Volume,' published in 1893 conjointly with his pupil, Miss Josephine Gordon Rich, there can be traced interesting continuity of ideas, and once again a primary association with Huxley, in the preparation of whose zoological masterpiece, 'The Crayfish,' Parker performed an honorable service.

The duties of office in New Zealand imposed upon Parker the Curatorship of the Otago University Museum and the conduct of a botanical class. Before leaving England he had established a reputation as a pioneer in the application of modern dry methods of micro-chemical technique to the study of vegetable histology, in a noteworthy paper read before the Royal Microscopical Society of London during March, 1879, and shortly after the commencement of work at the Antipodes he announced (Trans. New Zealand Institute for 1881) the discovery of sieve-tubes in the marine Algæ (*Macrocystis*). While for the latter Parker's memory will find a place in the history of botanical discovery, in the performance of his curatorial duties he will be remembered as having most successfully overcome the difficulties of preservation of the cartilaginous fish skeleton in a dry state, as may be witnessed in that of a large *Carcharodon* preserved in a British Museum of Natural History and in others at Otago, Cambridge and elsewhere.

In 1892 Parker paid a visit to Europe, returning in good health the following year. Family bereavement in the death of his wife then overtook him and laid the foundations of an illness from which he never recovered. Complicated by repeated attacks of influenza, this resulted in death, and during his long period of suffering and anxiety the like of which has killed many a man, he worked on undaunted, leaving unfinished an elementary book to have been entitled 'Biology of Beginners,' and some observations upon a series of 'Emen Chicks,' including those collected by Professer R. Semon during his recent sojourn in the Australian bush, which he was investigating in conjunction with Mr. J. P. Hill, the renowned discoverer of the allantoic placenta of *Perameles.* With these and other plans for future work well matured he has been cruelly torn from us, but while his memory will be a lasting heritage to those who knew and loved him, to the scientific world at large there has just been issued his final completed work, viz.: a general Text-Book of Elementary Zoölogy of some 4,000 pages in two volumes, upon which during the last 5 years he was engaged, together with his staunch friend and colleague, Professor W. A. Haswell, F.R.S. of the Sydney University. In this book, rich in original anatomical drawings, his influence will endure; and he will always be remembered as an earnest, loving man who performed his duties with a skillful hand, intent only on good work, the advancement of knowledge and the consequent betterment of the human race, an anatomist for whose life the world may be said to have been the richer and his fellow creatures the happier.

Parker was a Fellow of the Royal Society and a D. Sc. of London. He was also an Associate of the Linnæan Society of London and member of other scientific societies at home, in the Colonies and on the Continent of Europe. He took a pioneer's part in the literary undertakings of the Royal Microscopical Society, and in his public life by his miscellaneous addresses and speeches he aroused to admiration and friendship all with whom he came in contact.

G. B. H.

A COMMISSION OF PUBLIC HEALTH.*

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be established a commission of public health, to be under the supervision of a commissioner of public health, who shall have the aid of an advisory council consisting of a representative from each State and Territorial board of health, from the Department of Justice, and from the Medical Corps of the United States Army and Navy, the duties of which shall be to collect and diffuse information upon matters affecting the public health, including statistics of sickness and mortality in the several States and Territories; the investigation by experimental and other methods of the causes and means of prevention of disease; the collection of information with regard to the prevention of disease; the collection of information with regard to the prevalence of infectious, contagious and epidemic diseases, both in this and other countries; also the causative and curative influences of climate upon the same; the publication of the information thus obtained in a weekly bulletin; the preparation of rules and regulations for securing the best sanitary condition of vessels from foreign ports, and for prevention of the introduction of infectious or contagious diseases into the United States, and their spread from one State into another; which rules, when approved by the President of

* Abstract of a bill introduced in the House of Representatives, February 17, 1898, by Mr. Otjen, Representative from Milwaukee, Wis.

the United States, in so far as they are consistent with the existing laws, shall be adopted and enforced as quarantine regulations at the various ports of entry in the United States, and so far as applicable to interstate commerce, to prevent the spread of disease from one State or Territory or the District of Columbia into another State or Territory or the District of Columbia, shall be and become additional regulations thereof; the advising and informing the several departments of government on such questions as may be submitted by them to it, or whenever, in the opinion of the commission, such advice and information may tend to the preservation and improvement of the public health.

SEC. 2. That the commission of public health shall be under the control and management of a commissioner of public health. Said commissioner of public health shall be appointed by the President of the United States, by and with the advice and consent of the Senate, and his term of office shall be six years; he shall be a regularly educated physician holding a diploma legally conferred upon him by a legally incorporated medical college in the United States; he shall have had at least ten years' experience in the practice of his profession, and shall be learned in sanitary science, and shall hold a membership in one or more reputable sanitary or medical societies or associations in the United States.

SEC. 3. That the commissioner of public health may appoint an assistant commissioner of public health, who shall be a physician of good standing in the medical profession and skilled in sanitary science.

SEC. 4. That the commissioner of public health shall annually, on the second Tuesday of January of each and every year, and at such other times as he may designate, call to meet in the city of Washington, District of Columbia, an advisory council, to be composed of the commissioner of public health, the assistant commissioner, an officer learned in the law, detailed by the Attorney-General of the United States from the Department of Justice; officers from the Medical Corps of the United States Army and Navy, each to be detailed by the respective Surgeons-General thereof, and a representative from each State and Territorial board of health.

SEC. 5. That the commission of public health hereby created shall be provided by the proper governmental authorities with proper offices in the city of Washington, District of Columbia, said offices to be supplied with proper fixtures, laboratories and all needful apparatus and property; that the service known as the 'Marine-Hospital Service' shall be transferred to the said commission of public health hereby created, and shall be known as the 'Bureau of the Marine-Hospital Service;' and all laws governing the appointment to official positions in said Marine-Hospital Service, and to promotions in said service, shall continue in full effect, it being the intent and purpose of this Act to continue the Marine-Hospital Service in the performance of the duties for which it was lawfully created, and for such other duties as may be legally prescribed.

SEC. 6. The consular officers of the United States, at such ports and places as shall be designated by the commissioner of public health, shall make weekly reports to the commission of the sanitary condition of the ports and places at which they are respectively stationed; and the commissioner of public health shall also obtain, through all sources accessible, including State and Territorial sanitary authorities throughout the United States, weekly reports of the sanitary condition of ports and places within the United States, and shall prepare, publish and transmit to collectors of customs, and to State and Territorial boards of health, and through them to municipal

health officers and other sanitarians, weekly abstracts of the consular sanitary reports and other pertinent information received by him, and shall also, as far as he may be able, by means of voluntary coöperation of State and Territorial health authorities, and through them, municipal health authorities, public associations, and private persons, procure information relating to the climatic and other conditions affecting the public health.

Sec. 7. That a special report of the said commission of public health, relative to such action as will most effectually protect and promote the health of the people of the United States, may at any time be required by the President of the United States.

Sec. 8. That the commission shall coöperate with State, municipal, and local boards of health in establishing and maintaining an efficient and accurate system of notification of the existence and progress of contagious or infectious diseases, and of vital statistics in the United States.

CURRENT NOTES ON ANTHROPOLOGY.

CAN SEX BE DISTINGUISHED IN SKULLS?

Enthusiastic osteologists frequently assert that they can distinguish the sex by an examination of the skull. It is possible, when one is familiar with many skulls, from the same stock and geographically limited to narrow bounds, that this can often be accomplished. But in general it is not possible. There is no sex-criterion in the skull.

In an inaugural dissertation, published in Berlin last year, and noticed in the *Centralblatt für Anthropologie*, January, 1898, Dr. Paul Bartels submitted the question to a new and searching examnation, founded on 1,090 skulls—685 male and 405 female. He could discover no positive characteristic of sex. The fossa-typanico-stylo-mastoidea, of which much has been made, he shows to be inconclusive; and the same is true of every other trait which has been advanced as a determination of sex.

THE EARLIEST ITALIANS.

One of the numbers of the 'Piccola Biblioteca delle Scienze Moderne,' published by the Brothers Bocca, at Turin, is a treatise by Professor Sergi on the earliest inhabitants of Italy (Arii e Italici, pp. 229, illustrated).

The author's theory may be briefly stated. The oldest tribes on the peninsula, the Pelasgians and Ligurians, belonged to the 'Mediterranean' stock, which at a remote date moved northward from equatorial Africa. The Aryans entered much later, coming from the north, and originally from Asia, bringing with them the Umbrian, Oscan and other Indo-European dialects. The Etruscans, of unknown affinities, but members of the 'Mediterranean' stock, entered by sea, on the west coast, about 800 B. C., arriving from the eastern Mediterranean shores.

The author bases most of his argument on cranial forms, but also discusses with some detail the archæologic evidence, and slightly that derived from language. It is unnecessary to point out how many obstacles present themselves to such a solution of this intricate question.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

The *Chemical News* published two papers by Professor William Ramsay and Dr. Morris W. Travers before the Royal Society on January 20th. The first is on the homogeneity of helium. In a previous paper recently noticed in this column an account was given of an attempt to separate argon and helium into two portions of different densities, by diffusion through pipe clay. These experiments showed that while it did

not appear possible to thus separate argon into two gases there was more promise of success with helium. This experiment has now been carried out on a much larger scale with helium, and, while the gas is thus readily separated into a lighter and a denser portion, it is found that while the lighter portion is pure helium (density = 1.98), the denser portion is a mixture of helium with a small quantity of argon. The most careful experiments fail to show a trace of any new gas. It appears that every mineral which contains helium also contains a varying proportion of argon, with the exception of some cleveite from which argon is almost wholly absent. The gas from malacone, on the contrary, contains a larger proportion of argon than of helium. Professor Ramsay discusses the probability of the existence of a third gas, with an atomic weight of about 20, lying between helium —4 and argon —40. Such an element would correspond to the second element in each of the seven groups of the periodic system —chlorin, sulfur, phosphorus, etc. According to this view helium and argon would be respectively the first and third elements of the eighth group. It is true that argon has a higher atomic weight than the next following element, potassium of group first, but it is also true that cobalt appears to have a higher atomic weight than the following element, nickel, and tellurium than iodin. Professor Ramsay has hopes that the element with atomic weight 20 may yet be found among the gases evolved from some mineral and is continuing his search.

THE second paper mentioned is on Fergusonite—an endothermic mineral. This mineral is mainly a columbate of yttrium, with seven per cent. oxids of uranium. It also contains helium, and on heating to 500°–600° it suddenly becomes incandescent, evolving much of its helium, while its density decreases. The evolution of heat for a gram of the mineral was found to be 809 calories. The explanation of these characteristics seems to be that the mineral is a true endothermic compound of helium. At least two other minerals, gadolinite and æschinite, exhibit endothermic properties, but they increase in density on ignition, the cause being possibly polymerization, and hence they cannot be classed with fergusonite. Only the æschinite contains helium, and that in very small quantity. Professor Ramsay suggests that possibly these minerals, containing the rare elements, represent a portion of the interior of our planet, and their formation a condition of our earth realized only before solidification set in. Under the enormous pressure obtaining at the center, combination with helium was an exothermic event. Such compounds, in some unexplained manner having come to the surface where they are no longer exposed to pressure, have in consequence become endothermic. "The frequency of the helium spectrum in the stars and its presence in the sun makes it less improbable that some such explanation may not lie far from the truth."

IT was noted last week that E. Sonstadt had shown that platinum tetrachlorid is decomposed on boiling in very dilute solution, with the formation of platinum monochlorid, PtCl. He now shows in an article in the *Chemical News* that auric chlorid is similarly decomposed when heated in very dilute (1 : 15,000) solution, with the deposition of metallic gold. He supposes aurous chlorid, AuCl, to be first formed analogous to the case with platinum, but this decomposes into metallic gold and auric chlorid, hence only the metal is precipitate. Sonstadt considers that this is a general reaction for the higher chlorids of the metals of the platinum group.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE FOURTH INTERNATIONAL CONGRESS OF PHYSIOLOGY.

An International Congress of Physiologists is held triennially, with the object of contributing to the advancement of physiology by affording to physiologists of various nationalities an opportunity of personally bringing forward experiments and of exchanging and discussing views one with another and further of making mutual personal acquaintance.

At the conclusion of the Congress at Bern, in 1895, it was unanimously resolved that the Fourth International Congress of Physiologists should be held at Cambridge, England, in the present year. The usual circular letter of the Executive International Committee, concerning the arrangements for and regulations of the Conference, will be issued shortly after Easter. Meanwhile, the National Organizing Committee for the Congress send the following information:

The Congress will open on Tuesday, August 23d, and will hold sittings on that and the three immediately following days. The place of meeting will be the Physiological Laboratory of the University. The sessions will be devoted especially to experimental forms of demonstration. At the last Congress Professor Foster was elected President for the forthcoming Congress. Professor Foster has kindly expressed his readiness to afford to members of the Congress all possible facilities for experimental demonstration, as well as for the exhibition of preparations and of scientific apparatus. Three languages are recognized as official at the Congress, namely, English, French, German. Each member of the Congress is required to contribute the sum of ten shillings towards defraying the expenses of the meetings. In receipt for that subscription a card of membership of the Congress will be issued by the Local Secretary, Dr. L. E. Shore, Physiological Laboratory, Cambridge.

Those who intend to be present and those who wish to present papers should address the Local Secretary, Dr. L. E. Shore, Physiological Laboratory, Cambridge, before July 4th.

In connection with the Congress, an Exhibition of Physiological Apparatus will be held. Exhibits may be contributed by members of the Congress, by directors of physiological laboratories, and by makers recommended by any member or director. The exhibition of apparatus will open on Monday, August 22d, and remain open for the five following days.

The national organizing committee consists of M. Foster, *President*; C. S. Sherrington, *Hon. Secretary*; F. J. Allen, W. M. Bayliss, T. G. Brodie, J. S. Edkins, W. H. Gaskell, F. Gotch, W. D. Halliburton, J. B. Haycraft, Leonard Hill, J. N. Langley, J. G. M'Kendrick, C. MacMunn, O. Noel Paton, M. S. Pembrey, J. M. Purser, P. H. Pye-Smith, Waymouth Reid, W. Rutherford, J. B. Sanderson, E. A. Schäfer, L. E. Shore, W. Stirling, W. H. Thompson, A. D. Waller.

THE ALLEGHENY OBSERVATORY.

In order to retain the services of Professor James E. Keeler, who had been offered an important position in the Yerkes Observatory, steps have been taken at Pittsburg and Allegheny to build for him a new observatory with a thirty-inch telescope. It is to be hoped that the call of Professor Keeler to Lick Observatory, announced elsewhere in this issue of Science, will not interfere with the construction of a new observatory for the Western University of Pennsylvania. The present observatory is so surrounded by buildings and its equipment is so meager that it must be removed and enlarged if it is to maintain the rank given to it by Professor Langley and Professor Keeler. Allegheny City has given the University a site in an elevated position surrounded by parks and comparatively free from smoke, and the sum of about $100,000 has been subscribed towards the new building and its equipment. This sum, it is expected, will very soon be greatly increased. At the close of a course of lectures given at the Carnegie Library, Professor Keeler, as reported in the Pittsburg *Commercial Gazette*, referred to the need of a new observatory as follows:

"I desire to say a few words about a subject that should interest all very greatly. The object of this society is the diffusion of knowledge. It is well that we should found colleges and

societies and libraries to further this great purpose. But before the truth can be spread among the people it must be found; and a few men—a small minority of the world's population, but the leaders of the world's intellectual progress—are constantly engaged in pushing outward the boundaries of knowledge into the unknown. To one who knows that this minority exists and understands what it is, membership in it is one of the most enviable things that a man or an institution can win.

"Through the researches which Professor Langley carried on for years at the Allegheny observatory, we once had a high standing among the keen minds who are probing the secret places of nature, but the commercial activities of a great city have encroached upon the scene of scientific labor and the old observatory is shrouded in a pall of smoke. Its usefulness is at an end.

"We wish to build a new observatory. The city of Allegheny has reserved for us the excellent site in Riverview Park, two miles to windward of the present building, and practically free from smoke. Three years ago I drew a plan for an observatory to be placed upon this site. It provides for a thirty-inch telescope, an instrument which is large enough for the most advanced work, and yet not too large for convenience in operation, and all the accessory apparatus which the use of such a telescope requires. It also provides for a public department, with a thirteen-inch telescope, to which visitors will be freely admitted every clear night.

"The plan has been shown to a number of the most eminent astronomers in this country, and has met with their approval. The estimated cost is $175,000. In these two cities we have everything necessary to insure the successful carrying out of our purpose. Within a stone's throw of the observatory we have the best optician and instrument maker in the world. We have abundant wealth. All we need now is the will, and as some of our most eminent citizens are interesting themselves most unselfishly in the matter, I hope we shall not long want that. I ask all who wish to see Pittsburg an intellectual as well as a commercial center to lend us a helping hand."

THE BIOLOGICAL LABORATORY OF THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

THE next annual session of the Biological Laboratory will be held at Cold Spring Harbor, Long Island, during the months of July and August, 1898. The regular class work will begin on Wednesday, July 6th, and continue for six weeks. The laboratory will be open for work from July 5th until August 27th. Special students may make arrangements for using the laboratory from the middle of September, or later, if desirous of doing so. Application for admission to any course, except Zoology 1 and Botany 2, should be made on or before June 15th.

The laboratory has now possession of several buildings: 1. A large laboratory, accommodating about sixty students and fitted with aquaria, running fresh and salt water, private rooms, library, etc. 2. A lecture hall, used both for class lectures and for public lectures. It is furnished with an oxyhydrogen lantern. In the basement of this building is a dark room for photographing purposes, equipped with cameras and arrangements for ordinary photography, microscopic photography, lantern-slide making, etc. 3. A dining hall used for boarding the party. 4. Two dormitories for students, one of them being assigned to men, and the other to women. The rooms in these dormitories are newly furnished and are rented to students for a small sum. In addition, the laboratory is furnished with a naphtha launch, small boats, collecting apparatus, bacteriological apparatus, books, and all small apparatus needed for carrying on laboratory work. A limited number of microscopes are furnished the students, although each person is urged to bring a dissecting and a compound microscope if possible. The laboratory has also the advantages of the aquaria and appliances of the neighboring hatchery of the New York Fish Commission. The laboratory fee, including any one course of instruction, the general lectures and the use of laboratory privileges, will be $20. For each additional course of instruction there is an additional fee of $5. Except in the courses in Zoology 1 and Botany 2, students not provided with compound microscopes of their own will be charged $5 for the use of a microscope. Board will be

furnished for $4.50 per week. Rooms in the dormitories cost $1.50 or $3.00 per week, according to size.

In addition to the regular courses of instruction popular lectures will be given, open to the members of the laboratory and the friends of the school. Professor Charles L. Bristol, of New York University; Smith Ely Jelliffe, M. D., of New York; Dr. George H. Parker, of Harvard University; Mr. Gerrit S. Miller, of the National Museum, Washington; Professor Richard E. Dodge, of the Teachers' College, New York, and Mr. D. S. Judge, of the United States Department of Agriculture, will be among the lecturers.

Full courses are offered by the following board of instruction: Charles B. Davenport, Ph.D., Harvard University, General Director of the Laboratory; Professor H. T. Fernald, Ph.D., State College, Pa., instructor in zoology; D. S. Johnson, Ph.D., Johns Hopkins University, instructor in botany; C. P. Sigerfoos, Ph.D., University of Minnesota, assistant in embryology; Professor W. H. C. Pynchon, Trinity College, instructor in photography; Nelson F. Davis, Ph.D., Bucknell University, instructor in bacteriology; Henry R. Linville, Ph.D., New York City High School, assistant in zoology; Mrs. Gertrude Crotty Davenport, past instructor in Kansas University, instructor in microscopical methods.

GENERAL.

PROFESSOR JAMES E. KEELER, director of Allegheny Observatory, has been elected by the regents of the University of California director of Lick Observatory, to succeed Professor Edward S. Holden, who recently resigned, after twenty-five years' service.

THE Imperial Academy of Sciences of St. Petersburg has awarded its Shubert prize, for the greatest work in theoretical astronomy, to Professor Simon Newcomb.

THE laboratory of the United States Fish Commission Station at Wood's Holl, under the direction of Professor H. C. Bumpus, has been opened and a number of investigators are already at work. Men of science who wish to carry out research in the laboratory or suggest lines of investigation should communicate with the director.

DR. CHARLES WARDELL STILES, of the United States Department of Agriculture, has been appointed attaché to the United States Embassy in Berlin. Dr. Stiles's duty will be to keep the Agricultural Department informed on important discoveries and other matters of interest to agricultural science, to defend American meats, fruits and other exports against unjust discrimination, and to advise the Secretary of Agriculture from time to time concerning the purity of the food products that are shipped from Germany to the United States. It is said that the appointment of Dr. Stiles will probably be followed by other similar appointments, and it consequently represents an important advance in the application of scientific principles to diplomatic and commercial affairs.

WE regret to record the death, at the age of eighty-one years, of Sir Richard Quain, the eminent British physician and writer on medical subjects.

MR. G. K. GILBERT, of the United States Geological Survey, gave a lecture on the history of the Niagara river at Vassar College on March 10th.

THE London Physical Society has elected as honorary members Professor Riccardo Felici, of Pisa, and Professor Emilio Villari, of Naples.

AT its meeting of March 9th the American Academy of Arts and Sciences elected Albert Heim, of Zurich; Friedrich von Recklinghausen, of Strassburg, and Ferdinand Brunetière, of Paris, as foreign honorary members.

MR. G. J. SYMONS, F.R.S., has been presented by the Prince of Wales with the Albert medal of the Society of Arts for his services to meteorology.

A COMPLIMENTARY dinner was given in London on February 26th by his old students and friends to Professor M'Kenny Hughes, to celebrate the completion of his 25 years' tenure of the Woodwardian professorship of geology at Cambridge. Between 60 and 70 guests, many of them ladies, were present, including, in addition to old students, Sir Archibald Geikie, of the Geological Survey, who presided, and

Mr. W. Whittaker, President of the Geological Society. An illuminated address was presented in the name of the old students by Dr. R. D. Roberts and Mr. Strahan. Professor Hughes has also been presented with a loving-cup by his former students.

A BUST of the geologist Freiherr H. von Foullon, who was killed in the Solomon Islands in 1896, has been placed in the Geological Institute of the University of Vienna.

MAYOR VAN WYCK, of New York, has appointed Mr. Michael C. Murphy, a Tammany politician, to the presidency of the health board of the city.

THE Ninth International Congress of Hygiene and Demography will, as we have already announced, be opened at Madrid on April 10th and will be continued for one week. The exhibition of hygiene will, however, be open for three months. Scientific papers must be sent before March 15th. They may be written in Latin, Spanish, Portuguese, Italian, French, English or German, but must be accompanied with a short summary written either in Spanish or in French. The Spanish railways and steamship companies have made a reduction of 50 per cent. to all attending the Congress.

THE American Neurological Association will hold its twenty-fourth annual meeting on May 26, 27 and 28, 1898, in New York, at the Academy of Medicine.

THE Senate Committee on Commerce has authorized Senator Quay to report as a separate bill the amendment to the Sundry Civil Bill proposed by Senator Penrose in aid of the industrial exposition proposed to be held in Philadelphia in 1899. The bill appropriates $200,000 for a government exhibit and provides for the admission of foreign articles free of customs duties.

APPROPRIATIONS have been proposed in the Massachusetts Legislature giving $4,000 for a forest survey of the State and $2,000 for a survey of the lakes and ponds.

IT is reported that the Duke of the Abruzzi has had a conference with Captain Sverdrup on the subject of his projected expedition to the Arctic regions. The Duke will leave next summer for Spitzbergen in order to explore the country, but the expedition will not start until 1899, and its first objective will be Franz Josef Land. Should the conditions of the ice be favorable, depôts will be established, and an attempt will be made to reach the Pole by means of sledges and dogs. In the event of this, however, proving impracticable, the expedition will confine itself to an exploration of Franz Josef Land. On the advice of Captain Sverdrup, the Duke will ask the Danish government for a supply of dogs from Greenland, as these are considered to be the best.

THE *Evening Post* reports that the great painter, Mr. G. F. Watts, is an associate of the Society for the Protection of Birds, and feels strongly about the fashion of using the plumage of birds for millinery purposes. He is now painting a picture representing an angel with bowed head and desparing figure bending over a marble tomb covered with birds' wings, while a spirit of evil grins below.

THE publishing house of G. T. H. Fischer, Cassel, announces several new additions to its series of zoological charts prepared under the supervision of the late Professor Rudolph Leuckart and Dr. Carl Chun.

Subscriptions to the fund being collected as a memorial to the late Edmund Drechsel should be sent to Professor Kronecker, Bern, not Berlin, as given in a recent issue of this JOURNAL.

UNIVERSITY AND EDUCATIONAL NEWS.

THE will of the late Amos R. Eno contains several public bequests, including $50,000 to Amherst College.

MISS HELEN GOULD, New York, has given $20,000 to Rutgers College.

MR. ANDREW CARNEGIE has given $50,000 for a technical school at Dumferline, Scotland.

DR. GEORGE S. FULLERTON has resigned the Vice-Provostship of the University of Pennsylvania. He will retain the professorship of philosophy, but will take a year's leave of

absence for research in Europe. Professor Fullerton never intended to retain the Vice-Provostship of the University, and only accepted the position while the University was being reorganized after the election of Provost Harrison.

PRESIDENT ANDREW S. DRAPER, of the University of Illinois, having declined the Superindency of the schools of New York City, Dr. W. H. Maxwell, Superintendent of the Brooklyn schools, was elected Superintendent on March 15th.

OF the three travelling fellowships annually awarded at Bryn Mawr College, two have been awarded in the sciences—the President's fellowship to Miss L. R. Laird, a student of physics, and the Mary E. Garrett European fellowship to Miss F. Peebles, a student of biology.

MR. D. E. O. LOVITT has been elected assistant professor of mathematics in the John C. Green School of Science, of Princeton University.

PROFESSOR P. HENSEL, Strassburg, has been called to an assistant professorship of philosophy newly established at Heidelberg.

DR. GEORGE TREILLE has been appointed to the newly established chair of colonial hygiene in the University of Brussels.

THE University of Göttingen will again this year offer, during the Easter holidays, courses in science for teachers. No charge is made for attendance on these courses.

DISCUSSION AND CORRESPONDENCE.

THE LONGEVITY OF SCIENTIFIC MEN.

PROFESSOR EDWARD S. HOLDEN contributes to the last number of the *Cosmopolitan* an article 'On the Choice of a Profession: Science 'intended to be' of distinct use to young men and women of the Cosmopolitan University.' In the course of the article occurs the following:

> Among the advantages of following science as a profession we must certainly reckon its undoubted tendency to prolong the lives of its votaries. It is not a little remarkable that men of science, astronomers among them, are particularly long lived. The average longevity of men is about thirty-three years. Some one has had the patience to determine the average age of some seventeen hundred astronomers and mathematicians, and it turns out to be sixty-four years! That is, astronomers live nearly twice as long as men in general. * * * I think no one can fail to be surprised at the foregoing statistics.

Professor Holden is certainly right as to the surprise likely to be awakened by these statistics. An exclamation mark or a question mark would perhaps be sufficient comment for scientific men; but for the benefit of the young persons of the Cosmopolitan 'University' it may be explained that none of the 1,700 eminent astronomers and mathematicians died when they were infants. We do not know the average age at which work was done that would entitle a man to be included in this list of astronomers and mathematicians, but if it were forty years, we know that the expectation of life for men of that age is (according to tables of the Institute of Actuaries) 27.4 years. The average age at death of ordinary men would then be 67.4 years and of the astronomers and mathematicians, 64 years.

J. McK. C.

THE REVIVAL OF ALCHEMY—A REJOINDER.

IN SCIENCE of December 10th Dr. H. Carrington Bolton makes personal mention of me and inferentially describes me as being an 'educated charlatan' and as having 'cracked brains.' He also says, inferentially, that I belong to a class of persons who 'wear their feather in their heads,' an expression that is not very clear to me, but I suppose implies something more and worse than the feat ascribed in popular song to Yankee Doodle. But, however, this may be, I presume that, as a matter of even-handed justice, space will be accorded me in SCIENCE for the following reply:

1. Dr. Bolton's characterization of me is either a simple expression of his opinion or a conclusion from premisses.

2. Opinions need to be weighed before acceptance. Dr. Bolton says that "Sir Isaac Newton dabbled with furnaces and chemicals in true hermetic style; and Leibnitz showed the courage of his convictions by acting as Secretary of an Alchemical Society in Germany," and, further, that "so eminent a chemist as Sir Humphry Davy did not hesitate to affirm

that some of the doctrines of alchemy are not unphilosophical.'' This is an admission that the opinions of Newton, Leibnitz and Davy concerning alchemy were contrary to those now entertained by Dr. Bolton. On which side is the *weight?* Has Dr. Bolton ever distinguished himself by any scientific research? Has he made any notable discovery or invention? Has he propounded any law or doctrine of utility in the elucidation of natural truth? Or has he merely played the part of a scientific chronicler? If the answer to the last of these questions be in the affirmative, I think the scientific world will be slow to admit Dr. Bolton's authority to predicate 'cracked brains' in the cases of Newton, Leibnitz and Davy, or even in that of myself.

3. The bounden duty of a scientific chronicler is to be truthful and exact. Otherwise, his chronicles are misleading and injurious to the cause of science, and may seriously compromise the reputation of the journals that publish them. I regret very much to say that the article to which I am replying contains grave inaccuracies.

For example, after giving an account of Strindberg's famous gold-making experiment, Dr. Bolton says: ''After showing by appropriate tests that iron is still present, the hermetic chemist proceeds to explain the reaction by assuming the formation of the hypothetical $Fe_3S = 196 = Au$ * * * and he adds, 'The chlorid of gold is reduced by the nicotine of the cigar.' Since, however, no reagent containing chlorin in any form was used in the experiment, this element must have been created at the same time with the gold, which, however, is 'incomplete' gold soluble in unmixed acids.''

Now, I happen to possess a copy of Strindberg's 'Gold-Synthese,' and I am, therefore, able to quote his exact words, which are as follows:

''Man taucht ein Papierstreifchen in eine Lösung von Eisensulfat. Raucht über der Ammoniaksflasche, und es wird grün gefärbt (wie Goldoxidul); wärmt es über eine angezündeten Cigarre,* und es wird braun (wie Goldoxid). Später erscheinen gelbe metallische Flittern, welche aus Gold in äusserst verdumtem Zustande bestehen.''

* Nikotin reducirt Gold.

Here it will be seen that not a word is said about chloride of gold or chlorine.

Perhaps Dr. Bolton has never seen Strindberg's 'Gold-Synthese,' and by reporting and quoting at second-hand has inadvertently borne false witness against his neighbor. An explanation is certainly in order.

Another instance of inaccuracy is the reference to Tiffereau. Dr. Bolton gives an account of a memoir submitted to the Académie des Sciences in which carbon-compounds were said to have been formed by the action of nitric acid on metallic aluminum; and he says, by way of comment: ''Analytical chemists would criticise this experiment in several points; they would say Tiffereau did not demonstrate the absence of carbon in the metal used, and that he depended upon smell and taste for proofs of the carbon compounds.''

The memoir here alluded to was merely a preliminary announcement. It was followed by another describing a much more complete test, in which the flask containing the nitric acid and aluminum was connected with one containing baryta-water, this latter showing a deposit of barium carbonate at the conclusion of the experiment. Tiffereau's exact words are as follows:

''Un chimiste expert, chargé de l'analyse, a trouvé dans le flacon *a*, du nitrate d'aluminum et un partie silicieuse dont le poids, aprés incineration, a été de 0.018.

''L'analyse du dépot du flacon *c* a décélé la presence du carbonate de baryum melangé avec de l'alumine dans les proportions suivantes—

Carbonate de baryum . . .	0.129
Alumine	0.005
Poids du dépot . . .	0.134

''L'expérience a donc donné 0.00785 de carbone, alors que l'aluminum employé n'en contenait que 0.00075, c'st à dire, 10 fois moins.''

I ask all fair-minded men of science whether justice was done to Mons. Tiffereau in Dr. Bolton's paper, and whether the latter can be accepted as a scientifically-veracious account of a scientifically important research?

4. I now proceed to consider whether Dr. Bolton's attribution of 'cracked brains' to Newton, Leibnitz, Davy and myself, and his

wholesale denunciation of 'a company of educated charlatans' by whom he says 'the revival of alchemy is now being engineered' are indeed logical conclusions from admissible premisses.

His argument seems to be as follows:

A. Certain substances, each of which possesses certain specific physical properties, are by chemists denominated 'elements.'

No human being can, by any method, effect any change in any specific physical property of any 'element.'

Any human being who ventures to think that any method has been, or may yet be, discovered of changing any specific property of any element is, to that extent, insane.

Newton, Leibnitz, Davy and Emmens have been thus bold.

Ergo, they have 'cracked brains.'

B. Souls do not exist. There is no God. The universe consists solely of what physicists call Matter, Ether and Energy.

Any system of thought and research which enquires into Soul, as well as into Matter, Ether and Energy, is quackery.

Certain writings of certain members of a certain Society are based upon the recognition of Soul as an operative existence in connection with Matter, Ether and Energy.

Ergo, this Society is 'a company of educated charlatans.'

C. The honorary members of every Society must be adjudged to participate in the views expressed by all the writings of all the members of such Society.

Flammarion, Strindberg and Emmens have been elected as honorary members of the Alchemical Association of France.

Ergo, they are 'educated charlatans.'

If the foregoing tissue of self-evident nonsense be not a fair presentation of Dr. Bolton's argument, let him correct it. Should he attempt to do so, *while preserving a syllogistic form*, the result will be instructive to himself.

5. Finally, it is proper for me to state where I actually stand as regards the whole matter.

I do not claim, and have never claimed, to *make* gold in the alchemical sense of the phrase.

I do not ask, and have never asked, the scientific world for any recognition of my work in connection with the interchangeability of gold and silver. This Dr. Bolton has long known. At his request I sent him a copy of *Arcana Naturæ* in which is set forth a letter written by me on May 21, 1897, to Sir William Crookes, F.R.S. That letter contained the foling words:

"The gold-producing work in our Argentaurum laboratory is a case of sheer Mammon-seeking. It is not being carried on for the sake of science or in a proselytizing spirit. *No disciples are desired and no believers are asked for.*"

I have, however, given every chemist and physicist the opportunity, if desired, of investigating the fundamental portion of my work. The necessary instructions for the requisite experiment have been widely published. I have thus shifted the *onus probandi*. Let the critics do a little solid scientific work as a foundation for their clamor before they snap at the heels of men who make discoveries while they ply idle pens.

I do not profess to have shown how gold or its simulacrum may be produced at a commercial profit. I should, indeed, have 'cracked brains' were I to part with the control of the greatest power the world has ever witnessed.

I do, however, profess to be utilizing this power for the good of science at large. In addition to various physical researches of great interest and importance now being prosecuted in the Argentaurum laboratory, I am aiding students of nature in all parts of the world to observe and collate *facts* in rectification of much hypothesis that now does duty for truth. By so doing I, of course, incur the enmity of those who bow the knee to Mumbo-Jumbo; but many a broad-minded and eminent leader of science is corresponding with me in terms of amity and sympathetic encouragement.

Stephen H. Emmens.

Addendum. I take this opportunity of making an explanation with reference to another matter.

It will be remembered that in SCIENCE of February 19, 1897, Professor R. S. Woodward noticed a book of mine entitled 'The Argentaurum Papers No. 1.' The notice was not a review and made no attempt to deal with any of the arguments in the book. It was merely a personal attack upon myself in terms calculated to seriously injure me in the exercise of my profession as a scientific expert. Self-defense was, therefore, necessary; and as I had what I judged to be good reason for supposing that the columns of SCIENCE were closed against any reply on my part, I laid the matter before my legal advisers, and, in accordance with their counsel, I commenced an action for libel against the 'responsible editor' of SCIENCE and Professor Woodward. I fully recognized the inexpediency of such actions as a general rule, and the desirability, in the true interests of philosophy, of permitting absolute freedom of criticism; but I supposed, in this particular case, that an appeal to the law was the only remedy within my reach. I have recently been led to understand that this supposition is erroneous, and that the right to be heard in self-defense was not disputed by the editor of SCIENCE. Under these circumstances I have no intention of proceeding further with the action for libel.

Since writing the foregoing I have received a letter from a very eminent Fellow of the Royal Society informing me that he has performed the crucial experiment suggested in my letter of May 21, 1897, to Sir William Crookes. The gold contained in a Mexican dollar after forty hours of intense cold and continued hammering was found to be 20.9 per cent. more than the quantity of gold contained in the same dollar before the test.

S. H. E.

SCIENTIFIC LITERATURE.

Encyclopédie scientifique des aide-mémoire, Les huiles minérales, Petrole, Schiste, Lignite, par FRANCOIS MIRON. Licencié ès Sciences Physiques Ingénieur Civil. Publiée sous la direction de M. Léauté, Membre de L'Institut. Paris, Gautier-Villars et Fils.

There are no deposits of petroleum in France of commercial value. This fact may furnish a reason why no work upon petroleum of any value has been published in France.

When, a few years since, after a visit to Trinidad, I published a paper on the celebrated Lake, in the *American Journal of Science*, I sent a copy of the paper to M. Alphonse Daubrée and asked him to secure its translation and insertion in some reputable French scientific journal. It was reprinted entire in the *English Geological Magazine* and it was also translated and inserted in one of the scientific journals of Germany. M. Daubrée replied that, while he would like to comply with my request, the French journals printed only original articles. This statement may further explain why the papers of Dr. Hunt, published thirty years ago in French journals, are still quoted by French authors as if they were the only papers extant upon American petroleum. This fact may still further explain why the work before us, which forms a part of an 'Enclyclopédie des Aide-Mémoire,' is neither up to date nor correct to any date. Although the title page is without date, it appears to be just issued; yet the latest date mentioned in association with American petroleum is 1888 and with European petroleum is 1892.

Speaking of the distribution of petroleum, our author says, "In Ohio the deposits of Trumbull, Loraine and Washington were known from time immemorial." These counties are arranged inversely as to their importance, and the Trenton limestone deposits of northwest Ohio—by far the most important of all—are not mentioned at all. He says further, "In Colorado at Cañon City, in Michigan on the shores of Lake Huron, the county of Cumberland in Kentucky and the environs of Santa Clara county in California have yielded and still yield an important production." There is no production at all in Michigan, none of any importance in Cumberland county, Ky., and in California, while petroleum is found in Santa Clara county, the large and important production in that State, is yielded in Los Angeles and Ventura counties, several hundred miles south, between Santa Barbara and Los Angeles.

In his table which shows the geological distribution of petroleum the very important Trenton limestone deposits are not mentioned;

neither are the scarcely less important Tertiary deposits of California, the West Indies and South America. Again he says, "In certain deposits in America, above all, the pressure of the gas upon the oil is feeble; in Russia, on the contrary, it is very strong;" further, "It results that in America the greater part of the wells are exploited with pumps, whilst in Russia they spout of themselves." Proceeding, he illustrates the occurrence of petroleum in the crust of the earth with a diagram, which shows a subterranean chamber containing salt water, petroleum and gas in position, one below the other.

Now, these statements as to the gas pressure and pumping wells in the United States are absolutely false, and, while the theory that large cavities in the crust of the earth were filled with gas, oil and water, ranged according to their specific gravities, was broached by Professor E. B. Andrews more than thirty years since, it never found general acceptance, even at that early date, and has been wholly disproved years ago.

Concerning the origin of petroleum, he refers to Hunt's papers, printed nearly forty years ago, and has not a word to say concerning those of Lesley, Orton, Ashburner, Carll, Sadtler, etc.

We look in vain for any adequate statements concerning the nitrogen content of bitumen, particularly petroleum. But little more satisfaction can be found in the meagre notices of the work of Mabery and Smith upon the sulphur compounds of petroleum. And this is the more noticeable, inasmuch, as by referring to these papers at all, the author has shown himself not wholly unacquainted with the subject.

Perhaps one of the most remarkable examples of inadequacy, when due regard is had to the abundance of material from which to draw, is found in the figures and descriptions illustrating the methods and apparatus employed in drilling wells. As reference is made to Boverton Redwood—misspelled Bowerton—it might be inferred that M. Miron was acquainted with the classical work of that author. If he is, we do not understand why such puerile efforts were made, both in matter and quality of designs, to illustrate drilling tools.

But little more satisfaction can be gained from a perusal of the pages devoted to the processes employed in refining petroleum. While the descriptions are correct as far as they go, the illustrations are meagre and wholly unsatisfactory.

At page 127 we reach the consideration of schist oils, an industry which ought to be the pride of every Frenchman. The reader is informed that the origin of this industry dates from 1830, and was founded upon the efforts of the celebrated chemist Laurent, who discovered that, in distilling the schists called bituminous in closed vessels, a liquid was obtained susceptible of giving, after appropriate treatment, refined products like gasoline and the lamp oil of petroleum, as also heavy lubricating oils and paraffine. This statement, while partly true, is most astonishing, as the records of the French Patent Office show that long previous to the publication of Laurent's paper in 1833 —not 1830—several French inventors had been at work on both these products and processes, and that while Laurent earned well-merited distinction in perfecting them the real merit of their invention belongs to several others, but especially to Sèlligue, who obtained his first patent in 1834, but who, according to his own statements, had been already many years at work on the development of his methods.

A lack of time and space prevents a further pursuit of details. To say that the book has no value would be saying too much; to say that the author had used a great opportunity to very little purpose would not be far from the truth. Why an author in any language should refer to Boverton Redwood's work on Petroleum, which is filled with reference to original articles in all languages, and leave out of consideration the papers of Lesley, Orton, Ashburner, Carll, Stevenson, Sadtler, etc., is difficult of explanation.

We would suggest that some French author who reads English should read the several hundred original papers extant on American petroleum, and give to French scientific literature a compendium of information on that interesting subject that would be, at the same time, full, reliable and up-to-date.

S. F. Peckham.

A Short Handbook of Oil Analysis. By AUGUSTUS H. GILL, S. B., PH.D., author of 'Gas and Fuel Analysis for Engineers;' Assistant Professor of Oil and Gas Analysis at the Massachusetts Institute of Technology, Boston, Mass. Philadelphia, J. B. Lippincott Company; London, 6 Henrietta Street, Covent Garden. 1898.

This little book is exactly what it professes to be—a short handbook. Yet, it is very seldom that one finds a book that contains more valuable material than is condensed within its one hundred and thirty-six pages. The book is not only very full and complete in itself, but its very extended references converts it into a catalogue of a small library of books and articles upon the subjects treated in its pages. This gives the book a value comparable only to the well known work of Allen, which appeared about ten years ago. In respect to convenient size for the laboratory table Dr. Gill's book is much to be preferred, while a very careful examination has failed to discover the omission of anything of importance, while absence of unnecessary details and the clear and systematic arrangement cannot be too highly commended. The book, too, belongs to that class that is not alone useful to the professional chemist, but is equally so to the practical technologist. It must not, however, be mistaken for a work on the technology of oils, which it is not.

The whole subject of 'Oil Analysis' has been covered so evenly and well that we found no occasion to call attention to particular pages. We commend the book as one that no chemist or technologist can do without.

S. F. PECKHAM.

Zur Kenntniss der Kern und Zelltheilung bei den Sphacelariaceen. Von WALTER T. SWINGLE. Berlin. 1897. Sep.-Abdruck, Pringh. Jahrbücher, B. XXX. H. 2–3, pp. 53, pl. 2.

Mr. Swingle is to be congratulated upon having made a considerable addition to the cytological knowledge of a group, which has received a great deal of attention from investigators. The important results were obtained, without exception, from the apical cell of *Stypocaulon scoparium.* The paper is quite complete historically and morphologically, but derives its chief interest from the additional light it throws upon much debated questions in cytology.

According to the author, kinoplasm and trophoplasm are not only sharply differentiated in the Sphacelariaceæ, but the trophoplasm manifests also a distinct separation into a peripheral coarsely reticulate portion, and a much more finely reticulate central portion. The marked structural demarcation of the two parts is heightened by the presence of numerous granules in the outer meshes of the coarser portion. The same peculiar granules are found in the finer reticulum, and here and there throughout the cytoplasm, though in reduced number. The significance of this peculiarity of the trophoplasm admits at present of no adequate explanation. One cannot, however, feel quite as certain as the author that it is not an artefact. As for the kinoplasm, it is remarkably distinct and persistent.

The achromatic spindle of *Stypocaulon* is more or less unique in its development. It consists of three sets of fibres, those of an incomplete central spindle, those of the mantle, and certain free fibres which have no equatorial connection. The author concluded that the spindle arises from the intrusion of the kinoplasmic fibres, since the radiations in the kinoplasm decrease concomitantly with the appearance of the achromatic spindle. This might easily happen, however, as Cheviakoff has suggested, by the solution and transfusion of the kinoplasmic substance. The actual intrusion of the fibres of the kinoplasm could only be proved by the observation of the punctation or perforation of the nuclear membrane itself.

The investigation of the nucleolus in *Stypocaulon* furnishes no definite support to any of the multitudinous hypotheses concerning its presence and function. The author rather inclines to the view that the nucleolus may be a special store of organic nutrition for the kinoplasmic elaboration of the achromatic spindle. The centrosomes are permanently present in the kinoplasm, and undergo division regularly. In this connection, it is interesting to note the recently enunciated opinion of Carnoy, to the effect that the nucleoli of the pronuclei of *Ascaris* become the centrosomes, and that there

is, in consequence, no division of the centrosomes.

The cell wall, arising after division, is apparently built upon the walls of those meshes of the reticulum that come to lie in what corresponds to the equatorial plane. From the author's statement, however, it is not improbable that a more or less rudimentary phragmoplast really exists.

Das kleine botanische Practicum. Von EDUARD STRASBURGER. Jena, Gustav Fisher. 1897. Pp. 246, with 121 illustrations.

In the third edition of this excellent handbook, the subject-matter has been largely added to, chiefly on the subjects of microtomy, manipulation and Bacteriaceæ. The remainder of the text is essentially the same as in the second edition. It is quite superfluous to call attention to the originality and authoritativeness of the text, and to the excellence of the illustrations. The book has been long enough before botanists to be thoroughly and favorably known. It is inexplicable that, with such an adequate text accessible, each year should see the publication of text books which serve to overcrowd an already well-filled oblivion. In all cases it may not be possible, for lack of time, to offer so thorough an elementary course as that outlined in the Practicum. In such instances, it would be practicable to omit a certain amount of detail without detracting from the integrity or thoroughness of the work. At all events, the system is one that, from the kind of training it involves, should be generally in vogue. FREDERIC E. CLEMENTS.

THE UNIVERSITY OF NEBRASKA.

Stones for Building and Decoration. By GEORGE P. MERRILL, Curator of Geology, U. S. Museum. Second Edition, revised and enlarged. New York, J. Wiley & Sons; London, Chapman & Hall. 1897. 8vo. Pp. ix + 506.

The first edition of this excellent work was based upon the handbook of the same author and his catalogue of the building stones in the United States National Museum at Washington. The treatise here presented consists of the original, with revised and rewritten matter, and well-illustrated text, brought down to date and in various ways improved. Many pages of new matter appear in the new edition and full-page plates have been interspersed in the text. Part I. consists of a discussion of the distribution, the composition and the character of the building stones of the United States, studied from the points of view of the physicist, of the chemist and of the geologist, as well as of the engineer and the architect. Part II. is devoted to 'Rocks, Quarries and Quarry-Regions,' and presents a detailed account and discussion of the several rocks employed in the arts, their composition, their varieties and their special characteristics. This section of the work is its principal portion, covering about 300 pages. Part III. describes the methods employed in quarrying, dressing and shaping stone, stone-cutting machinery, weathering, testing, protection and preservation. Part IV. consists of appendices of tabulated and other data relating to the valuable qualities of the stones, prices and costs, a list of important stone structures with dates of erection, and a bibliography and glossary. Eighteen figures in the text and nineteen full-page plates fully and handsomely illustrate the work.

The position and experience of the author of this treatise give ample guarantee of its accuracy, and an examination of the text will afford confirmation of this conclusion. It is well planned, well executed and exceptionally complete. The publishers have given it admirable form, a plain but neat and satisfactory binding, the press work and paper are good and the illustrations excellent, as a rule. The book has a good index. It will prove helpful to the architects and engineers of the country whenever important stonework is to be erected.

R. H. T.

SOCIETIES AND ACADEMIES.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

January 6, 1898: Fourteenth annual meeting. The address of the retiring President, Mr. C. L. Marlatt, was upon the subject of 'Old World Entomology.' The author recounted personal experiences and impressions gained during a four months' European tour, in the course of which matters entomological—and particularly as an applied science—were espe-

cially investigated. The aim was particularly to make the personal acquaintance of the men charged with official work in this field, and with the conditions under which work is done in Europe, as a basis for estimating the methods there employed for the new world. The address covered only the places visited and the individuals seen, and laid no claim, therefore, to being a complete review of the subject of applied entomology in Europe. The author discussed the status and condition of entomological museums, the official economic work, both in the central national bureaus and connected with agricultural, horticultural and forestry schools, and also the work carried on by private enterprise. Much attention was given to the forestry conditions, the methods of culture of fruit, etc., and also to the climatic and topographic features as bearing on the abundance of and control of injurious insects. The countries especially discussed were England, France, Switzerland, southern Germany, Austria-Hungary, Italy and Spain. The worst injurious insects of the countries named were particularly studied, and especially those that so far have not reached America, and which, it is extremely desirable, should be kept from gaining lodgment here. In this connection were mentioned particularly two important grape pests, the Cochylis *Tortrix ambiguella*, and the Pyrale *Tortrix pilleriana*; also the olive fruit fly of France, Italy and Spain, *Daucus oleæ*, and some insect enemies of forage crops and grasses. The present status of the gipsy moth in Europe was also particularly investigated.

In summarizing the results of the trip, the author laid stress on the exceptional weather conditions of the season covered (Aug.–Nov., 1897), which, on account of excessive rainfall and unusual cold, led to a great scarcity of insect life, and also to the absence of insect damage, which was almost complete. In fact, with the exception of the olive fruit fly, no serious damage by insects was noted in either forest growth or in the various fruit districts. It was pointed out that the deductions from a single season are, therefore, necessarily unfair and do not apply to normal conditions. The fact, however, that the climate of most of central and southern Europe is unfavorable, as a rule, to the abundant production of insects was strongly urged, and it was asserted that the immunity from insect damage in Europe generally as compared with America is almost solely attributed to this fact rather than to any exceptional efficacy or abundance of parasitic and predaceous insect enemies of the injurious species.

In the matter of the treatment of destructive insects it would appear also that we have little to learn or gain from the study of European methods, for the simple reason that the injury is so much less frequent and less serious that wholesale methods of control, such as are necessary here, are seldom or never employed. This applies especially to the scale insects. The grape must always be excepted, this being perhaps the only crop where the European and American grower meet on equal terms in the matter of insect enemies. The author gave as his belief that the greatest benefit to be derived from the study of applied entomology in Europe is in the ability to more correctly appreciate the facts of climate, forest growth and methods of culture of fruits, etc., pertaining there, without a personal acquaintance with which it is impossible, except in a general way, to determine the applicability of methods of work followed for conditions on this side of the Atlantic, which, while apparently often similar, are altogether different.

February 10, 1898: 132d regular meeting. Specimens were exhibited as follows:

By Mr. Ashmead, the male and female of *Hypota pectinicornis* from south Europe; remarkable from the flabellate antennæ of the male.

By Mr. Schwarz, cocoons of *Cactophagus validus*, taken from the trunk of the giant cactus, at Tucson, Ariz., by Mr. Hubbard. In these cocoons in the winter time occur dead and mutilated specimens of an undescribed species of Bothrideres, which are unable to escape and die within the cocoons.

By Mr. Pratt, a specimen of *Lachnosterna inversa*, collected at Keokuk, Iowa, by Dr. Shaffer, and bearing on its thorax two eggs of a dipterous parasite.

By Mr. Fairchild, a Javanese Phyllium closely resembling the guava leaf; also a photo-

graph of a mantid which mimics the coffee flower.

By Mr. Banks, a specimen *Tetragonophthalma dubia*, collected in the District of Columbia, and which is the first species of its family to be found in the local fauna.

By Mr. Schwarz, seeds of the sea grape of Florida, *Coccoloba uvifera*, with specimens of *Pseudomus inflatus* reared from the seeds by Mr. Hubbard.

Papers were read as follows:

By Dr. Smith, a discussion of recent papers on hemipterous mouth parts by Dr. Leon and Dr. Heymons. Dr. Smith showed that in his opinion the points brought out by these writers substantiate his position that the hemipterous beak is a maxillary structure, although both authors start with the assumption that it is labial.

The paper was briefly discussed by Messrs. Cook, Banks, Howard and Gill, all taking issue with Dr. Smith's conclusions.

By Mr. Banks, on Tarsonemus in America, describing *T. pallidus* n. sp., occurring on Chrysanthemum at Jamaica, N. Y., and collected by Mr. Sirrine.

By Mr. Cook, on a new family of Diplopoda from Alabama, describing *Desmonus earli* and the new family Desmonidæ.

L. O. Howard,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 481st meeting of the Philosophical Society was held at the Cosmos Club at 8 p. m., March 5th. The first paper was by Mr. A. Lindenkohl, of the United States Coast and Geodetic Survey, on 'The Specific Gravity of the Waters of the Northeast Pacific Ocean.' The salient points of the address were as follows:

The discussion of temperatures and densities is mainly based on observations by the 'Challenger,' 'Vitiaz' and 'Albatross.' In the deeper parts of Bering Sea a minimum of temperature of 2°.8 is found in 146 metres depth, succeeded by a maximum of 3°.5 at 410 metres, thence a decrease to 1°.6 at the bottom. The density increases from the surface to the bottom, where it is as great, if not more so than in the open Pacific. The cold zone about the Kuriles is correctly ascribed by Makarof to the upheaval of cold water from lower strata. A feeble drift, the Davidson Eddy, is found along the northwest coast of America, and off the southern coast of California a warm and saline body of water is found in the summer to intervene between the coast and the cold California current. The 'Challenger' soundings indicate a constant sinking to a lower level of the waters of the South Pacific in their advance against the equatorial currents, attended by a rising of the colder waters of the latter towards the surface. The higher temperature and salinity in the greater depths near the Gulf of Panama is ascribed to the same cause. The greatest surface density thus far found is by the 'Vitiaz,' viz.: 1.0276 in Latitude 23° 50′ North and Longitude 163° 16′ East.

The second paper was by Professor Frank H. Bigelow, of the United States Weather Bureau, who gave a paper on the results of balloon ascensions in determining the temperatures of the air. An account of the several phases of the problem, produced by the different stages of condensation of the aqueous vapor in the atmosphere, and a distinction of the types of the vertical temperature gradient, introduced the subject. Then a recital of the most important voyages, and the statistics derived from them, was made, showing the data we have to work with. Next followed the details of the reduction and combination of the observations, and the method was explained of constructing a network diagram giving the gradients from the ground up to 16,000 metres and the heights of the isotherms throughout the year. The data was subdivided into High Areas, or Clear Weather, and Low Areas, or Cloudy Weather, and the courses of the gradients occurring in the morning and the evening hours, respectivley, were traced out. They diverge in the lower atmosphere, but converge in the neighborhood of 5,000 metres, whence a single line is traced to the upper limit, where the temperature has a nearly total constant fall from the ground in winter and summer. Emphasis was laid upon the fact that good mean results can be obtained from inferior data by the method of construction employed.

E. D. Preston,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON—288TH MEETING, SATURDAY, FEBRUARY 26.

THE evening was devoted to a 'Symposium on the Teaching of Biology,' in which Messrs. E. L. Morris, W. H. Dall, Erwin F. Smith, Theo. N. Gill, H. J. Webber, B. W. Evermann, C. W. Stiles and E. L. Greene took part. The general consensus of opinion was that there should be more general zoology and botany taught than at present, and more work tending towards a knowledge of the principles of classification and the systematic arrangement of the various groups.

F. A. LUCAS,
Secretary.

TORREY BOTANICAL CLUB, FEBRUARY 8, 1898.

THE evening was devoted to the Asclepias, or Milkweed family.

The first paper was by Dr. H. H. Rusby, describing 'A New genus of Asclepiadaceæ from Bolivia.' Dr. Rusby discussed the tribal and generic characters of that family, and exhibited specimens of his new genus, which is a vine of vigorous growth and of pollinial position.

The second paper, by Miss Anna M. Vail, describe a new species of *Acerates*, or green-milkweed, with comparisons of the other species already known. Specimens and illustrations were exhibited, with remarks upon the history of the genus from its earliest species, *A. Floridana*, onward. As distinctive characters of *Acerates*, she mentioned its aspect, its form of hood and its lack of strong horn-like characters. The characteristics were further discussed by Dr. Edward L. Greene, who was present from Washington, and who emphasized the importance of its axillary subsessile umbels and the green color present in its flowers. The varieties of *Acerates viridiflora* were then discussed, especially with reference to their great difference in leaf-form. Miss Vail finds their flowers to be identical. Mr. Rydberg reported finding all four of these forms within one county of central Nebraska on the sandhills, but to the east the broader-leaf only and in western Nebraska a narrow-leaf variety only.

General discussion on the Asclepias family followed, participated in by Professor Greene, Dr. Britton, Dr. Rusby and others. Miss Vail, in answer to inquiries, indicated the difficulties in the way of regarding the horn in that genus as a midrib. It is very variable, often double, differs in character from the still-persistent midrib of the same hood, and in many Western species is replaced by a broad triangular lamina.

Miss Vail described her results when watching plants of *Asclepias Cornuti* last summer. Bees and many small insects directed themselves at at once to the glutinous top of the anther-column. They seemed to neglect the corona, and but little secretion was apparent in it, instead of the copious deposits of honey expected.

Professor Greene queried if the corona in this family might not prove to be the true corolla, and cited the Malvaceæ as similar in adhesion of the corolla to the stamen-tube. He said: "I would exclude from *Asclepias* every species which does not develop a terminal umbel. The only invariable character by which I would distinguish *Asclepias* and related genera is found in the anther-wing. The first index to a new genus is its aspect. It is the part of the systematic botanist to define, if possible, what the significant elements of this habit or aspect are. Habit is often strongly marked, even where clearly-accented charactêrs are difficult to find. It is a nice genus which has both habit and clear characters."

Dr. Britton followed with description and exhibition of a new saltmarsh *Scirpus*, or bulrush, from Connecticut, related to *S. robustus* of Pursh, but with different inflorescence and achene. Dr. Britton also presented specimens of *Triosteum angustifolium* from Stratford, Ct., its previously-known stations northeast of Pennsylvania being only at New Brunswick, N. J., and Glen Cove, L. I. A large supply of roots from Stratford are now planted at the Botanic Garden to exhibit development.

EDWARD S. BURGESS,
Secretary.

SCIENTIFIC JOURNALS.

THE second number of the *American Journal of Physiology* opens with a demonstration by Professor W. T. Porter of the compression of the intramural vessels of the heart by the

squeeze of the contracting heart-muscle and an experimental analysis of the effect of this compression on the circulation through the walls of the heart. This is followed by an elaborate study of the influence of alcoholic drinks upon digestion by Professor Chittenden, Dr. Mendel and Mr. Jackson. The effect of distention of the ventricle on the flow of blood through the walls of the heart, the composition and nutritive value of edible fungi, the restoration of coordinated volitional movement after nerve 'crossing,' the digestive powers of papain, the gastric inversion of cane-sugar, and the structural changes in infusoria produced by lack of oxygen, are treated in investigations from the laboratories at Yale, Harvard, Columbia and Chicago. The contents of the first number are not less varied. The influence of borax on nutrition, the recovery of the heart from fibrillary contraction, the variations in daily activity produced by alcohol and by changes in barometric pressure and diet, the influence of high arterial pressure on the blood-flow through the brain, the elimination of strontium, the nutrition of the heart through the vessels of Thebesius and the coronary veins, the relation between the external stimulus applied to a nerve and the resulting nerve impulse as measured by the action current, the nature of the cardio-pneumatic movements, and the functions of the ear and the lateral line in fishes, is each the subject of a thorough experimental study by physiologists of the leading American universities. The excellence and the wide range of the seventeen contributions in the first two numbers of this journal, and the unanimous support that it receives from the physiologists of America, assure us that physiology now has in this country a special journal in the first rank. Much praise is due for the form in which these investigations are published. The quality of the paper, the design of the cover and the page, the press-work, and especially the beauty of the illustrations, are all most gratifying.

American Chemical Journal, March. 'On the Conversion of Methylpyromucic Acid into Aldehydopyromucic and Dehydromucic Acids:' By H. B. HILL and H. E. SAWYER. On the 3, 4, 5, 'Tribromaniline and some Derivatives of Unsymmetrical Tribrombenzol:' By C. LORING JACKSON and F. B. GALLIVAN. 'A Convenient Gas Generator, and Device for Dissolving Solids:' By T. W. RICHARDS. The author has devised a simple form of apparatus in which the material can come in contact with the fresh liquid, while the heavy solution produced by the reaction is withdrawn by means of a tube reaching to the bottom. He also gives a description of an apparatus to be used to increase the rate of solution of crystallized substances. 'A Redetermination of the Atomic Weight of Zinc:' By H. N. MORSE and H. B. ARBUCKLE. By this work a correction has been made in the results obtained by Morse and Burton, as it has been shown that the oxide of zinc occludes both oxygen and nitrogen even at very high temperatures. This correction has raised the atomic weight to 65.46 from 65.33, the result obtained by Morse and Burton. 'Direct Nitration of the Paraffins:' By R. A. WORSTALL. 'On the Silver Salt of 4-Nitro 2-Aminobenzoic Acid and its Behavior with Alkyl and Acyl Halides:' By. H. L. WHEELER and B. BARNES. 'Formamide and its Sodium and Silver Salts:' By P. C. FREER and P. L. SHERMAN, JR. 'A Study of the Reaction of the Diazophenols and of the Salts of Chlor- and Bromdiazobenzene with Ethyl and with Methyl Alcohol:' By F. K. CAMERON. The author studied the influence of the hydroxyl group and of chlorine and bromine upon the decomposition of diazo compounds.

J. ELLIOTT GILPIN.

A SCIENTIFIC paper, the *Forward*, has recently been established in Denmark and is said to have already a circulation of 100,000 copies, while maintaining an excellent standard of popular science. We have not seen a copy of this journal, but if the facts are as represented the two and a-quarter million people of Denmark are to be congratulated on their scientific interests.

HERR GUSTAV FISCHER, Jena, has begun the publication of a *Centralblatt für die Grenzgebiete der Medizin und Chirurgie.*

M. BALLIÈRE, Paris, has begun the publication of an Atlas of Microbiologie, by M. E. Macé, the first part of which contains twenty colored plates.

SCIENCE

FRIDAY, MARCH 25, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*IATRO-CHEMISTRY IN 1897.**

PHINEAS T. BARNUM, the prince of American showmen, discovered early in his successful career that 'the people like to be humbugged,' and he showed great ability in profiting by this weakness; it must be said to his credit, however, that he always honorably gave the people full value for their money. This love of humbug seems to be exceedingly strong in respect to the healing of diseases, and in all ages those who practiced the art have taken advantage of man's credulity; it is not necessary to transcribe the contents of that model of condensation, Thomas Joseph Pettigrew's treatise on superstition in medicine and surgery (London, 1844), to convince my hearers of this truth. In 1897 we expect better things; we are prone to believe that the universal education of the masses, the popularization of the facts and theories of science, fit the people to appreciate at their true value the claims of charlatans. Americans looking reverently to the Old World, where brilliant lights illumine the paths of philosophy and sciencc, hardly expect to find there also the deepest shadows of ignorance and credulity, yet no higher position can be assigned to the modern adaptation of Iatro-Chemistry known as 'Electro-Homeopathy.' Originating in Italy, it has taken root in Germany and flourishes in

*Read at Washington Chemical Society, February 10, 1898.

France; more than one hundred publications, including three journals devoted to the cause, attest its influence and its popularity.

The founder of this novel school of chemical medicine, Count Cesare Mattei, was an interesting character; he owed his higher education to a duel and his medical knowledge to his neighbor's dog. He was most successful in organizing a huge scheme for swindling unfortunate victims of disease, though unable to plead poverty as an apology; to his dupes he posed as a philanthropist and his friends regarded him as a second Æsculapius. Mattei was born January 11, 1809, at Bologna, in the palatial residence of his parents; his primary education was in local schools, but at the age of nineteen he lost his father, who bequeathed him a princely estate and a fortune, whereupon he spent several years in travel and gay life. He seems, however, to have turned his attention to medicine at an early date, for he published a work on 'Treatment for Cancer' in 1830.

When about thirty years of age Mattei fought a duel with a young blade, after a quarrel at a masked ball, and soon after he attacked his adversary in a satirical pamphlet, which greatly amused the fashionable circles of Bologna. This pasquinade fell into the hands of Paolo Costa, the venerated instructor of youth, who sought out Mattei and in a single interview effected his conversion to the serious study of philosophy. The quondam duellist became Costa's favorite pupil in the physical and natural sciences and in literature.

The troubled years 1847–1849 threw Mattei into public life, and championing the cause of Pope Pius IX. the latter rewarded him with the title of Count and other honors. Retiring to an old castle, on his estate, which he had sumptuously restored in Moorish style, Mattei devoted himself to the study of botany, chemistry and physiology. He adopted the principles of Hahnemann, but was not satisfied with the curative results of this system of medical practice.

One day, while promenading on his estate, he noticed a dog, belonging to a neighbor, eagerly devouring certain plants which the animal's instinct had showed him was suited to his condition. Mattei at once began a series of investigations which resulted in the discovery of an entirely original materia medica and an amazing philosophical system. He collected the plants sagaciously indicated by the dog, and extracted from them, by processes known only to the medieval Iatro-Chemists, the active principles. With these he experimented on the poor peasants living on his estate and ascertained that they had extraordinary power in curing all scrofulous diseases. He next examined other vegetable growths and little by little discovered other active principles, thus building up a unique materia medica. This comprises 38 medicines, of which 32 are in the form of pills and 6 in the shape of fragrant, colorless liquids.

Instead of naming the first discovered medicine after his neighbor's dog, he ungratefully called it 'Antiscrofoloso No. 1,' which, for convenience, is abbreviated to 'Scrofoloso No. 1;' this proved to be a veritable panacea for the greatest variety of ailments, healing 90 per cent. of the patients who came under his care. Eight other medicines received the name 'scrofolosa,' being distinguished by appropriate numbers and adjectives; ten of them are dubbed 'canceroso,' and the rest are varieties of angioitico, pettorale, febbrifugo, vermifugo, linfatico, venereo, and so forth. Five of the six colorless liquids were colored to facilitate differentiation, and are named 'red electricity,' 'yellow electricity,' 'blue electricity,' 'green electricity' and 'white electricity.' The sixth liquid, known as 'Aqua per la pella'

(skin-water), completes this remarkably simple materia medica. These nostrums affect beneficially different organs and parts of the body; 'Scrofoloso No. 5' is prescribed for diseases of the skin, the muscles and the spinal marrow; 'Canceroso No. 2' is particularly good for subcutaneous cellular tissue; 'Angioitico No. 1' affects the heart, the blood vessels and the arterial circulation generally. Nearly all the medicaments are used internally and externally with equal success; moreover, when administered internally, the nature of their action depends on the size of the dose, even contrary results being obtained by varying the quantity prescribed. This property compensates for the small number of medicines; and the more ill the patient the smaller the dose of the required article.

The five vegetable electricities 'level the differences of tension of the polarities in the nervous system;' the blue electricity acts on the arterial system, the green on the veinous system, and the white is neutral and can be used indifferently. The yellow electricity can be given safely to hysterical persons.

As might be expected, this method of treatment has been applied to the domestic animals, and the literature of the subject contains a 'Veterinary Guide' (Bologna, 1893).

The fame of Mattei's cures attracted to Bologna pilgrims from far and wide, to the great dissatisfaction of the regular physicians. In 1869 Pope Pius IX. gave him part of the hospital at Santa Theresa, where he accomplished such marvellous cures that the crowds had to be controlled by soldiers. In the same year the first publications appeared, of which the most noteworthy is that by Dr. C. F. Zimpel, entitled: 'Therapeutics of Vegetable Electricity.' For many years Mattei treated all patients gratuitously, but when he saw conscienceless speculators reaping a harvest by the misuse of his system he organized in his palace a commercial company for the manufacture of medicines and the protection of the public.

Meanwhile the Count devoted his tireless energies to other matters; he improved the neighboring roads, built bridges and looked after the material and spiritual welfare of those living on his domain. At present the palace of Mattei is almost entirely given up to the industrial enterprise; the official organ, *Moniteur de l'Electro-Homéopathie*, is edited there, and the Bolognese mansion is the center of benign influence. Mattei lived in simple luxury; he never married, but devoted himself to the philanthropic work of diminishing the sum of human misery and the accumulation of personal wealth.

He died April 3, 1896, and was buried in a sepulchre of his own construction at his castle of Rocchetta; the business of manufacturing vegetable electricity of all colors being now carried on by his adopted son, Mario Venturoli-Mattei.

Verily the *limbus fatuorum* needs to be most spacious!

The disciples of Count Mattei allege that he possessed occult knowledge of nature derived from the iatro-chemical school founded by Paracelsus, though some claim for it still greater antiquity. "Passing by Plato, Moses and St. John," writes *Saturnus*,* "the history of spagyrical philosophy begins with Albertus Magnus, Raymund Lully and Roger Bacon, of the thirteenth century, but reached its highest development under Paracelsus." One of its brightest luminaries was Hahnemann. Mattei, however, is said to have found the kernel of his philosophy in the writings of John Baptist van Helmont, who died in 1644. Since that time the knowledge of secret medicines has been preserved

* Iatro-chimie et Electro-Homéopathie. Traduit de l'Allemand. Paris, 1897. 18mo. Portraits of Paracelsus and Count Mattei.

by members of occult fraternities; they alone understood the mystical, spiritual application of the remedies, while the "profane wearied themselves in vain efforts to discover the arcana of the Iatro-Chemists, to the great amusement of the initiated, and in spite of whose ironical smiles, they boil, fuse, distil and digest only to find that they are lost in a labyrinth from which there is no exit." The adversaries of this system claim that it is nothing more than an old woman's fancy, but its advocates point to the brilliant careers of Kepler, Dante, Leonardo da Vinci, Shakespeare, Goethe, Sir Isaac Newton and Richard Wagner, to prove the contrary.

The characteristics of esoteric science are said to be: "The principle of analogy and its consequences; the relation of the forces and the laws of the macrocosm to those of the microcosm; logical investigation both experimental and speculative; the reciprocity of cause and effect determining the oscillations of blind chance." Only students of these principles are able to apply the mysterious remedies of the new therapeutics so as fully to secure miraculous efficiency.

An important factor in iatro-chemical philosophy is the influence of the sun, moon and planets on diseases; the moon especially excites dreams, insomnia, somnambulism, and governs the periodicity of fevers. But the most potent of all celestial influences is the 'odic-magnetic virtue of the stars.'

A notable feature, overlooked by official medicine, but rescued from oblivion by the promoters of Electro-Homeopathy, is the peculiar way in which 'odic force' is distributed in the human body; it flows along three principal axes, head to feet, left side to right side and back to chest; this polarized fluid is assimilated by the five vegetable electricities, which explains their efficiency. Physicians who appreciate the importance of the 'three axes of odic-magnetic polarity' place their patients in bed on their right sides (−), with their heads (−) to the north (+) and their faces (+) to the wall.

The chemical philosophy of this school has the merit of simplicity; the unity of matter and the four ancient elements are the basic principles. Fire is hydrogen; Air is oxygen; Water is nitrogen, and Earth is carbon; the alchemical salts, sulphur and mercury are respectively the principles of solidity, volatility and liquidity. The Alkahest, or universal solvent, of spagyrical philosophy is acetone; the *spiritus philosophorum* is not merely a liquid of superior medicinal potency, it is the "true spirit of the knowledge of control over Nature's forces, which results from unions with and absorption by the Divine Being."

The position of modern Iatro-Chemists with reference to the transmutation of metals is entirely favorable to the ancient doctrine. "Modern science," writes one, "regards the creation of gold as a superstitious fable, the product of medieval imaginations, but transmutation is an undeniable fact; a family beloved by the author preserves as a relic an ingot of gold, which an ancestor, initiated in the secrets of Hermetism, had manufactured by a formula now intelligible only to adepts." *L' Hyperchimie*, the organ of alchemists in France, has recently added Electro-Homeopathy to the subjects it advocates, and contains an enthusiastic review of the latest treatise on this medical practice; the review concludes with the remark that: "Occult therapeutics is destined to become the system of the future, as it has been that of the past, for it demonstrates with invincible logic the admirable unity of the sacred sciences."

The literature of this amazing quackery is already large; books explaining the system have been published in French, German, English, Swedish, Polish, Spanish and Hungarian, besides the original Italian. France, Germany and England have their

monthly journals devoted to the propagandism of the system. Advertisements in the press of Europe and South America announce that certain physicians practice Electro-Homeopathy at given addresses. One of these doctors seeks pupils, to introduce the practice into all parts of the world, and the 'people who love to be humbugged' will doubtless give them cordial support.

"No class escapes them, from the poor man's pay,
The nostrum takes no trifling part away."—*Crabbe.*

Thoreau has remarked that "Nothing more strikingly betrays the credulity of mankind than medicine; quackery is a thing universal and universally successful. In this case it becomes literally true that no imposition is too great for the credulity of men." This is confirmed by the existence of another enterprise recently started and still wilder in its philosophy than Mattei's system, styled 'Hermetic Homeopathy.' Rejecting the modern theory of vitalism, the promoters of this school revert to the old hermetic science of the 16th century which yielded such marvellous results but is to-day treated with ridicule and disdain. They accept the doctrines of Paracelsus as respects the *mumia*, advocate cure of diseases by transplantation, and regard astrology as indispensable to a physician. The remedies and elixirs of Hermetic Homeopathy are prepared in the laboratory of two Past Masters in Occult Science, under the direction of the Secretary of the Alchemical Society of France, with magical incantations and under the most favorable conjunctions of the planets. Among the cure-alls offered is the panacea of the alchemists, potable gold. Disciples of Hermetic Homeopathy advocate treatment of diseases by transplantation, their reasoning is the same as that of Paracelsus: "Man possesses magnetic power by which he can attract good and bad subtile emanations just as a magnet attracts particles of iron. Of iron a magnet can be made that will draw to itself iron, and in like manner of vital substance a magnet can be made that will attract vitality. Such a magnet is called *magnes microcosmi* and it can be prepared of substances that have remained some time in the human body and that have become impregnated with vitality. Such are hair, excrements, urine, blood, etc., and a magnet made of any of these and applied to the diseased organ, or part of the body, will diminish the inflammation in that part because it attracts the superabundance of magnetism conveyed there by the flow of blood. In a similar way diseases may be transferred to healthy animals, or even to other persons, on which fact sorcery is based. This explains, argue the writers, the action of poultices, of plasters and of leeches.

The difference between ordinary homeopathic practice and that of the hermetic school is shown in the manner of treating measles; an old-fashioned practitioner would prescribe pulsatilla and aconite, with belladonna. A disciple of Mattei would administer scrofoloso, increasing the dilution as the disease becomes more serious; the hermetic homœopathist puts the patient to bed and covers him with blue or violet coverlids and surrounds him with blue or violet curtains. Provided the patient is sanguine or bilious, but if he be lymphatic or nervous then rose or green hangings and bedspreads should be used. At the same time the air of the room must be ozonized, the patients' wrists must be surrounded with metallic gold, and the water in which the hermetic globules are dissolved must be positively electrified. When convalescent the patient must have sun-baths, cold-water douches, water-baths or air-baths, according to his temperament, lymphatic, nervous, sanguine or bilious. When able to leave the house he must take steam-baths charged with ammonia on four days.

Of course this school of medicine has its

monthly organ, published in Paris, now in its second year, *Thérapeutique Intégrale.* Its guiding spirit is Dr. G. Encausse, known to modern alchemists as Papus, the author of many treatises on the ancient pseudo-science. As apostles and forerunners of this system he claims Hippocrates, Paracelsus, Hahnemann.

All this would be very amusing if it were not sad—sad to find that educated men can so degrade their knowledge of chemistry, physiology and medicine; sad to think of the conceptions of these sciences formed by persons subject to the influence of these 'lewd impostors;' sad to think of the suffering that ensues for lack of proper treatment; sad to think of the unscrupulous immorality of those willing to trifle with human life for selfish gain. One is inclined to cry with Massinger:

> "Out you imposters,
> Quack salving, cheating montebanks, your skill
> Is to make sound men sick, and sick men kill."

H. Carrington Bolton.

THE DEVELOPMENT OF ELECTRICAL SCIENCE.

II.

The subject of telegraphy is closely associated with the present excellent system of electrical measurements and with the invention of many of our most delicate measuring instruments. As the applications of electricity increased there gradually grew up a new branch of engineering, a branch, however, in which the foot-rule, pound-weight, chronometer and thermometer were not sufficient. Other standards of measurement were required, in order that quantities could be gauged and consistent work done. The way to connect the measurements of the new quantities with the units already in use in dynamics had been pointed out by Gauss and others, and at the suggestion of Thomson the British Association appointed a committee in 1861 to determine the best standard of electrical resistance. This led to an unexpected amount of work not only on a standard of resistance, but also on the general subject of electrical measurement. The committee regretted, at the end of the first year, that it could not give a final report, but hoped that the inherent difficulty and importance of the subject would sufficiently account for the delay. It can hardly be said that the final report has yet been forthcoming, as a committee with some of the original members in it still exists and reports regularly every year on valuable work done by it. The committee worked energetically for a number of years, not only on the standard of resistance, but on those of current, electro-motive force and capacity. It incidentally supplied a great deal of quantitative data on a number of subjects and particularly as to the permanence of alloys, the variation of their resistance with temperature as depending on their composition and so forth. In looking over the results of the early work of the British Association committee one is apt to indulge in adverse criticism. It is hard for many of the younger workers to appreciate the difficulties which are met in a first attempt. It would be equally just to congratulate ourselves that we have better marksmen to-day than there were fifty years ago, without making allowance for the modern rifle.

The first absolute determination of resistance was probably that made by Kirchhoff about fifty years ago. Weber published his method in 1852, and then came the B. A. determination by Maxwell, Stewart and Jenkins in 1863. Neither of these were very exact, but they paved the way for the splendid exhibitions of experimental skill which followed. Among those to whom we are most indebted for this later work may be mentioned Kohlrausch, Rayleigh, Glazebrook, Rowland, Wiedemann, Mascart, etc. The greatest step in advance in recent years

has been the invention of the revolving disc method by Lorenz, of Copenhagen, and its subsequent improvement and application by himself and by J. V. Jones. The determinations made by the latter by this method are probably almost absolutely correct.

A subject which has attracted much attention comes in incidentally here, namely, the electro-magnetic theory of light propagation suggested by Maxwell. According to this theory the ratio of the electro-magnetic unit of quantity of electricity to the electrostatic unit ought to be the same as the velocity of light. In 1868 a determination of this ratio was made by McKichan under Lord Kelvin's direction, and gave close agreement with the theory. Since that time determinations have been made by various methods by Maxwell, Shida, Ayrtin & Perry, J. J. Thomson, Rosa, Lodge, Glazebrook and others, with the result that the ratio of the two units does not differ from the velocity of light by more than the probable error of observation. The work here referred to may not appear to be very directly associated with the determination of standards of measurements. It is, however, one of the investigations which has been made possible by the work of the B. A. committee in the production of instruments of precision. Prominent among these instruments stands the Kelvin electrometers, and particularly the absolute electrometer which was described in the report of the B. A. committee for 1867.

Another subject of great interest in itself and in connection with Maxwell's theory is that of the specific inductive capacity of dielectrics. Experiments on this subject were made by Faraday, but comparatively little was done before 1870, in which year an excellent paper was communicated to the Royal Society, by Gibson and Barclay, on the specific inductive capacity of paraffin. Since that time much good work has been done by Boltzman, Hopkinson, Quincke, Silow, Klemencic, Negreáno and others. The theoretical importance of these experiments is due to the fact, that, according to Maxwell's theory, the specific inductive capacity of non-magnetic dielectrics should be proportioned to the squares of their indices of refraction. A wonderful verification of Maxwell's theory was carried out only some ten years ago by Hertz, who showed not only that electrical waves exist, but also how to measure their wave length and period. We have in these experiments splendid illustrations of the oscillatory discharge referred to above, as discovered by Henry and predicted by Thomson, and as a result several new ways of determining electrical quantities have been developed. It is now possible, for example, to compare the capacity of condensers by means of oscillatory currents of exceedingly short periods, and thus to determine the dielectric constants of many materials to which the older methods were not easily applicable.

It is somewhat difficult to decide where to place a reference to the recent discovery of Röntgen and its development in photography, but probably it comes in well here. Just how to apply Maxwell's equation to Röntgen rays is not yet quite clear, but there is no doubt as to the great importance of the discovery.

As an outcome of all this activity in the determination of standards and in the absolute measurements of the electrical properties of materials, combined with the great commercial demand produced by the introduction of dynamo-machinery, we have now many excellent instruments at our disposal for absolute measurement and suitable either for practical applications or for the most refined laboratory work. For the production of these we are indebted to a host of inventors, prominent among whom may be mentioned Lord Kelvin, Lord Ray-

leigh, Ayrton & Perry, Mather, Swinburne, Cardew and Weston.

Magneto-electric and dynamo-electric generators and motors have now become so common that we are apt to forget that their introduction on an extensive scale has only taken a few years. Faraday's disc dynamo was, as has already been stated, produced in 1831, and a machine for generating electricity was made by Pixii in the following year. Pixii's machine consisted of a horseshoe permanent magnet which was rotated in such a way that its poles passed alternately in front of the poles of a similar electro-magnet. An alternating current was thus induced in the circuit which included the coils of the electro-magnet.

This machine was improved by Clarke, who removed the coils and put a commutator on the axis. Other machines were made or suggested by various physicists, and an important observation, which has since been frequently overlooked, was made at this time by Jacobi, who pointed out the importance of making the cores of the coils short. Sturgeon, in 1835, made a dynamo with a shuttle-shaped armature; a similar form has long been identified with the name of Siemens. Woolrich made a multipolar magneto machine in 1841 for electroplating, and Wheatstone about this time produced his small multipolar magneto, long used for telegraph purposes. In 1845 Wheatstone and Cooke patented the use of electro-magnets in place of the permanent magnets, and Brett suggested, in 1848, that the current from the machine might be made to pass round a coil surrounding the magnet and thus increase its strength. A similar suggestion was independently made in 1851 by Sinsteden. In 1849 Pulvermacher proposed the use of thin laminæ of iron for the cores of the magnet, a proposition which has since, but probably for a different reason, been almost universally adopted. Sinsteden used iron wire cores and made a number of experiments on the effect of varying the pole face. About this time another class of machines were proposed by Ritchie, Page and Dujardin. In these machines both the magnets and the coils were to be stationary, but the magnetism was to be varied by revolving soft iron pieces in front of the poles. Modern representatives of these machines are to be found in the dynamos of Kingdon, Stanley and others. All the machines up to this time had been of very small dimensions In 1849 Nollet began the construction of an alternating machine on a larger scale, but died before it was completed. Machines of Nollet's type were afterwards made by Holmes and by the Compagnie l' Alliance of Paris, the latter being called the Alliance machine. These machines were used for lighthouse purposes. Holmes's earlier machines were continuous current, but later he left out the commutator, and still later again introduced it on part of the coils for the purpose of obtaining current to excite his field magnets. This latter plan was introduced after the self-exciting principle had been introduced by Siemens and Wheatstone. A remarkable machine historically was patented in 1848 by Hjorth. In this machine a combination of the permanent and electro-magnet was used, the first to give magnetism enough to produce a current with which to excite the other. A similar idea was developed fifteen years later by Wilde with the difference that the permanent magnet part was a separate machine. The idea of using part of the current from the armature to excite or partially excite the field magnets was at this time in the minds of a number of workers, and some remarkable machines were patented by the brothers Varley, one of which containing both a shunt and a series winding has been held by some to anticipate the compound winding now in use. In 1867 it seems to have occurred independently to Wheatstone and E. Werner

Siemens that the permanent magnet part of the Hjorth and Wilde machines might be dispensed with, the resident magnetism being used to start the action. Siemens gave the name dynamo-electric machine to this type and it has stuck. In order to diminish the fluctuations in the strength of the current during one revolution of the armature Pacinotti devised his multi-grooved armature in 1864. This machine did not receive the notice it deserved for a number of years, and in the meantime Gramme produced his smooth ring armature in 1870. Gramme's machine was soon recognized as being of great merit, and its gradual introduction gave rise to increased activity. In 1873 the Hefner-Alteneck improvements on the Siemens armature were introduced and in the remaining 70's quite a number of forms of dynamo were invented, the Loutin type introduced in 1875 with improvement in subsequent years being one of the best. The early 80's saw tremendous activity; the patent offices in Europe and America were flooded with inventions of various types of dynamos and motors, of lamps for electric lighting and so forth. It is curious how few of those machines have stood the test of time and how well the old types of Pacinotti, Gramme, Siemens-Alteneck and Loutin in some one of their modifications hold the field. Great progress has been made in the last fifteen years. Machines have assumed enormous proportions and the number of branches of industry to which they have been applied is now very large. Much has been learned during this time, particularly with regard to alternating currents and their application to the transmission of power, the introduction of Multiphase systems being of considerable importance in this connection. In the direction of high potential and great frequency the work of E. Thomson and Tesla is of great interest.

Of the application of electricity to the production of light and heat little need be said in this connection. The difficulties to be overcome were largely mechanical, and with the progress made we are all familiar.

As regards primary batteries there has been, of course, as we all know, considerable progress since the time of Volta. The number of forms brought into use has been enormous and they have been important in increasing our knowledge of the relative electro-motive force of various combinations and in their bearing on chemical knowledge. It can hardly be said that an ideal primary battery has yet been obtained, when we look at the subject from a commercial point of view. Although the subject is not very much to the front at present, however, it is destined to come again, and will, I have no doubt, be, in a comparatively short time, one of our leading industries.

The work of Planté and of Faure and others on secondary batteries has been of great value commercially. They gave rise to several chemical problems, but the main difficulty here also has been of a mechanical kind, and they have not added much to the knowledge of electrical laws.

The transformation of alternating currents from high to low potential and *vice versa*, by means of what are commonly called transformers, has shown another remarkable development of Faraday's discovery of induced currents. The application of transformers has made it possible to distribute electrical energy over large areas in a moderately economical manner, and incidentally has led to considerable increase in the knowledge of the magnetic properties of iron.

One of the most important of the applications of electricity is that of electrochemistry. The chemical action of the electric spark was noticed by van Groest and Dieman in 1739 in the decomposition of water.

Beccari, about the middle of the 18th century, obtained metals from oxides through which the spark had passed, and in 1778 Priestley noted the production of an acid gas when the electric spark was passed through air. Similar experiments were made by Cavendish and Van Marum on decomposed ammonia. It is not, however, until after the discovery of the voltaic cell that the subject of electrolysis really begins. I have already referred to the discovery of Nicholson and Carlisle in 1800, and the subsequent work of Davy and of Faraday. The peculiar phenomenon of the appearance of separated elements only at the end plates in the electrolytic cell led to considerable speculation, and was explained by Grothuss on the supposition that the molecules separated into two parts, one positively and the other negatively electrified, and that these parts formed a chain between the plates along which chemical action traveled by a continual interchange of mates, the end parts going to the plates. This theory was held for many years, and is still to be found in some text-books. Faraday's work is by far the most valuable of the early contributions to the subject. He gave the following laws:

The amount of chemical decomposition in electrolysis is proportional to the current and the time of its action.

The mass of an ion liberated by a definite quantity of electricity is directly proportional to its chemical equivalent weight.

The quantity of electricity which is required to decompose a certain amount of an electrolyte is equal to the quantity which would be produced by recombining the separated ions in a battery.

These laws are all of the greatest importance and the last one clearly points out the reversibility of the electrical process. By forcing a current through an electrolyte it is decomposed and the mutual potential energy of the components consequently increased. By allowing the components to recombine in a battery the mutual potential energy is reduced and a current of electricity is the result. An excellent illustration of this action is exhibited by the secondary battery.

In 1857 Clausius gave a theory of electrolysis and at the same time reviewed the weaknesses of the hypotheses of Grothuss and others. Clausius assumes that the molecules of the liquid are in continual motion; that impacts frequently occur which produce temporary dissociation, leaving atomic groups charged with opposite electricities, and that during these separations any directive agency, such as an E. M. F., is able to cause a motion of these atoms in opposite directions. This is probably the first indication of the idea of the purely directive character of the applied electromotive force taking advantage of dissociation to produce chemical separation.

The energy side of the problem now began to attract attention and the development of what may be called the thermodynamics of electro-chemistry began. Among the most prominent workers in this field have been Joule, Helmholtz, Gibbs, Kelvin, Boscha and Favre.

In 1853 Hittorf made quantitative determination of the change of concentration near the electrodes when a current is passed through a solution. This work is of historical interest because it formed practically the starting point for what may be called the modern view of electrolysis. Hittorf's experiments extended over several years and served practically to establish the theory of the migration of the ions in the solution. Hittorf communicated the following laws:

The change in concentration due to current is determined by the motion which the ions have in the unchanged solution.

The unlike ions must have different velocities to produce such change of concentration.

The numbers which express ionic veloci-

ties mean the relative distance through which the ions move between the salt molecules, or express their relative velocities in reference to the solution, the change in concentration being a function of the relative ionic velocities.

Hittorf's analyses enabled him to give numerical values to these relative velocities. The experiments of Nernst, Loeb and others have extended Hittorf's results, and have shown that in dilute solutions the relative velocities of the ions are independent of the difference of potential between the electrodes and are only slightly, if at all, influenced by temperature. Hittorf pointed out that a knowledge of the conductivity of electrolytes should give valuable information in reference to the nature of electrolytic action. A great deal of work has been done in this direction by Horsford, Wiedemann, Beetz, the Kohlrauschs and others. The most notable, perhaps, was the work of P. Kohlrausch, who devised a method of measurement, using alternating current by which results of high accuracy were obtained. Kohlrausch's results give the sum of the ionic velocities, and thus, combined with the results of Hittorf on change of concentration, which gave the ratios, the absolute velocity can be obtained. It appears from these results that the velocity of the ion in very dilute solutions depends only on its own nature and not upon the nature of the other ions with which it may be associated. For example, the velocity of the chlorine ion is the same when determined from solutions of KCl, NaCl or HCl. The important general law has also been found that the conductivities of neutral salts are additively made up of two values, one dependent on the positive, the other upon the negative ion. If, then, the velocities of the ions themselves be known the conductivity of a salt may be calculated. The results of Kohlrausch received strong confirmation from some very ingenious experiments by Lodge and Whetham in which the migration of the ions was made to produce a change of color in the solution, and could thus be directly observed.

In 1887 the theory was advanced by Arrhenius and Ostwald that dissociation is directly effected by solution or fusion and that in very dilute solutions the dissociation is practically complete. Arrhenius holds that the ions carry charges of electricity, positive or negative, dependent upon their nature, but of equal quantity in every ion. The remaining part of the theory is similar to that of Clausius and others. According to this theory the ratio of electric conductivities for different densities of solution gives a measure of the relative dissociation or ionization. If the act of solution effects the dissociation necessary to admit of electrolysis chemically pure substances ought not to be decomposed by the electric current, and this is found to be the case. It is curious that two substances like hydrochloric acid and water, which separately are insulators, should, when mixed, conduct readily, and that practically only one of them should be decomposed. This, however, is only one of the many problems still to be solved. Another question is how do the ions obtain their electric charge? Still another, what is the nature of the force which causes ionization? There are many more.

When we turn to the commercial application of electro-chemistry we are met with astonishing evidence of activity. Only twenty years ago there was comparatively little evidence of the importance of this branch of applied electricity. At the electrical exhibition in 1881 electro-chemistry was apparently of comparatively little prominence. A factory which could produce a few hundreds of tons of copper electrolytically was considered a wonder. The production of thousands of tons a

month is beginning to be looked upon as commonplace. There is scarcely a metal which cannot be deposited electrolytically with comparative ease and the prices of some of the rarer metals is going down rapidly. Zinc used to be considered a difficult metal to deposit successfully. It is now produced in some of the Australian mines in almost a pure state from refractory ores at the rate of thousands of tons per annum. Similarly the old method of galvanizing is rapidly disappearing and electro-deposition is taking its place and this metal is now so deposited on the hulls of ships, on anchors and other smaller articles cheaply and perfectly. A new industry has practically sprung up and there is every indication that the technical chemist of the near future will have to take an inferior place unless he be also well versed in electricity and electrical appliances. This branch of applied science is revolutionizing many things. It has within a few years produced an enormous improvement in our magazine illustrations, and has, at the same time, reduced the cost of this kind of literature and of atlases and charts enormously. Electro-chemistry is now used on a large scale for the production of chlorate of potash, bleaching materials, alkalies, coloring matters, antiseptics, like iodoform, anæsthetics, like chloroform, etc. In fact, it is getting to be difficult even to enumerate the manufactures in which it is used. It has revolutionized the extraction of gold, and plants of enormous capacity are now in use in some of the gold fields, the poorest ores and tailings being made to yield up almost the last trace of the precious metal. The production of ozone by the ton, the purification of sewage and the sterilization of water are all accomplished facts.

Some progress has even been made in the introduction of chemicals through animal tissue by electrolysis or cataphoresis, and Röntgen has shown us how to see through the body.

Then, again, we have got the electric furnace, and with it the power to fuse almost the most refractory substances. In this way aluminum is now produced at a few cents a pound, whereas most of us remember when its price had to be reckoned in hundreds of dollars. In a similar way phosphorous is now produced on a large scale, as are also various carbides, carborundum, acetylene, etc.

It is impossible to look back over the history of electricity and its applications and notice the apparent geometric ratio in which advances are being made, and not to speculate on what a giant this science is going to become in another quarter of a century. Undoubtedly no one can study this one branch of science without being persuaded of the great value of scientific work for the advancement of human enterprise.

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*A PROPOSED BUILDING FOR THE SCIENTIFIC ALLIANCE OF NEW YORK.**

THE Scientific Alliance is the outgrowth of several conferences of commissioners from all of the societies now included in the Alliance (except the Entomological Society, which was not then in existence, and also of the New York Branch of the Archæological Institute of America, which, however, did not enter the final organization), called by a committee appointed by the New York Academy of Sciences, in February, 1891, 'to consider what methods might be adopted for mutual benefit and support.' The first meeting of the Commission was held at the American Museum of Natural History on March 11, 1891, and amongst the subjects discussed was 'the desirability

*Report of the Building Committee, C. F. Cox, Chairman, to the Council of the Scientific Alliance of New York.

of obtaining a building for a common meeting place of all the societies.' Thus, at the very outset of the movement, the idea of bringing the societies together under one roof was prominent in the minds of those who formed the Alliance.

At the first meeting of the Council, September 28, 1891, the President was 'requested to appoint a committee of seven to consist of himself as chairman and one member from each of the allied societies to consider the practicability of obtaining a building for the use of the Alliance.' Thus again the policy of seeking a common meeting place was made one of its main objects by the now fully organized federation.

On October 10, 1891, the Building Committee was appointed, and from that time to this it has not ceased to consider every suggested scheme and to follow every possible clue which seemed to lead to the attainment of its object. At the meeting of the Council held January 22, 1892, the committee presented its first report, in which it suggested three plans for consideration, as follows:

(I.) That the Alliance attempt to secure enough money by subscription to purchase land, erect a building and maintain it.

(II.) That the Alliance endeavor to obtain from the City or the State money to erect a building on public land, which would necessitate the raising of a guarantee fund for the support of the building which, obtained under these conditions, would belong to the City.

(III.) An informal suggestion from President Low, of Columbia College, that the Alliance should cooperate with the College in the erection of a building to be used jointly by the Alliance and the College.

The first of these plans was at the time considered impracticable, chiefly because of the financial depression then prevailing, and the continuance of the same condition has caused the committee to hold it in abeyance until now. The second plan had in contemplation an attempt to place the Scientific Alliance on a basis similar to that of the Museum of Natural History, assuming that the societies could render an equivalent for public aid by the maintenance of a scientific library and through courses of free lectures upon popular scientific subjects. The third plan, however, was the one which for the time being seemed to hold out the most hope of accomplishment and therefore met with the approval of the Council. The idea underlying it was that when Columbia University should remove to its new site and should dispose of its property on Madison Avenue it would still need a down-town building for its offices and perhaps also as a place for certain of its lecture courses. The scheme the committee had in mind was to endeavor to raise a sum of money sufficient to pay one-half the costs of such a building, in consideration of which the Council should have a perpetual use of a fair proportion of the rooms for the constituent societies, the title to the property to be taken by Columbia University. The Council authorized the committee to confer with President Low upon some such basis, and the matter was accordingly gone over with him, but without definite result.

Meanwhile the committee were informed that the Trustees of the fund left by the late Samuel J. Tilden, for the foundation of a public library, would be willing to discuss the question of devoting that fund to the purposes sought to be accomplished by the Scientific Alliance, namely, the erection of a building for the use of the allied societies, the establishment and maintenance of a library of general science, the endowment of original research and the publication of scientific memoirs and other papers; the idea being to found an institution for New York which should combine the objects of Burlington House and the Royal Institution of Great Britain, with the addition of a

department for the issue of a series of works similar to those published by the Ray Society and other learned bodies abroad. A number of interviews with the Tilden Trustees, collectively and individually, subsequently took place and, indeed, continued until the Astor, Lenox and Tilden foundations were united.

In September, 1892, your committee drew up a formal address to the Tilden Trustees, setting forth in detail the plan above referred to, and this communication was adopted by the Council, signed by all the members, and duly transmitted to the Trustees. The general scheme therein outlined seemed to receive the approval of several of the Trustees, and your committee felt greatly encouraged by their manifest interest in the matter. The President of the Tilden Trust gave it a particularly cordial reception, and in an article which he published in *Scribner's Magazine*, in September, 1892, referred to cooperation with the Scientific Alliance, on some such lines as proposed by us, as one of the possible methods of accomplishing the objects of Mr. Tilden's generous bequest. But when the Tilden fund was transferred to the Trustees of the New York Public Library it looked as if an end had been made of all the hopes we had built upon the negotiations with the Tilden Trustees. We owe it, however, to the Hon. Andrew H. Green that the subject was subsequently taken up, in a much modified form, by the Trustees of the Public Library, who appointed a committee to consider the matter. But that committee has never invited your Building Committee to a formal conference, and, as far as we can learn, has made no report to the appointing body. The Library Trustees, have, however, put upon record a resolution declaring the duties of the corporation, among which are included 'alliances or affiliations with the principal scientific societies of the city and the gathering together of their libraries and collections in the main building, and the furnishing to them of facilities for meetings, and arrangements for the giving of lectures on scientific, literary and popular subjects.'

On November 15, 1892, a joint meeting of the societies composing the Alliance was held in the lecture hall of the American Museum of Natural History, at which the aims of the Alliance were set forth in five carefully prepared addresses, and the project for the possession of a building was given a prominent place and fully elaborated. The proceedings of that conference were afterwards printed in pamphlet form and widely distributed and thus served to supplement the efforts of the Building Committee in making known to the public the purpose towards which it was working.

In December, 1892, negatiations were opened with the President of the American Museum of Natural History having in view a possible arrangement by which the societies in the Scientific Alliance might become, at least temporarily, tenants of the Museum. These negotiations have been dropped and resumed at different periods, and at one time took the form of a proposal that the Museum authorities should cooperate with the Council of the Alliance in procuring legislation which would enable the Alliance to construct a building on the northwest corner of Manhattan Square, the architecture to be such as to harmonize with that of the Museum, with the idea that whenever the Museum should cover the rest of the Square the Alliance building would form an integral part of the general structure or group of structures. The scheme was worked up out of deference to the opinion of many members of the Alliance who thought it most natural that the scientific societies should be affiliated with the Museum for mutual helpfulness and for the creation of a great scientific center at Manhattan Square. But no encouragement was

obtained from the Museum authorities for this comprehensive plan and it was soon abandoned. We did, however, receive some encouragement for the idea of occupying rooms in the Museum building, as tenants at pleasure of the Trustees, but when we came to discuss the details of such an arrangement so many administrative difficulties were discovered that it was deemed impracticable.

In January, 1893, the question of removing the present City Hall to Bryant Square and devoting it to the use of the Tilden Trustees for library purposes was under discussion and it looked as if it might be decided affirmatively. Your committee took advantage of this situation to address a memorial to the Municipal Building Commission, which had the matter in charge, urging that, in case the City Hall was to be converted to educational purposes, the Scientific Alliance be given a permanent home in it in return for such services as it could render the public through the use of its libraries and free lecture courses. It was not necessary to pursue this project long, because public sentiment compelled the abandonment of the plan for removing the City Hall from its present site.

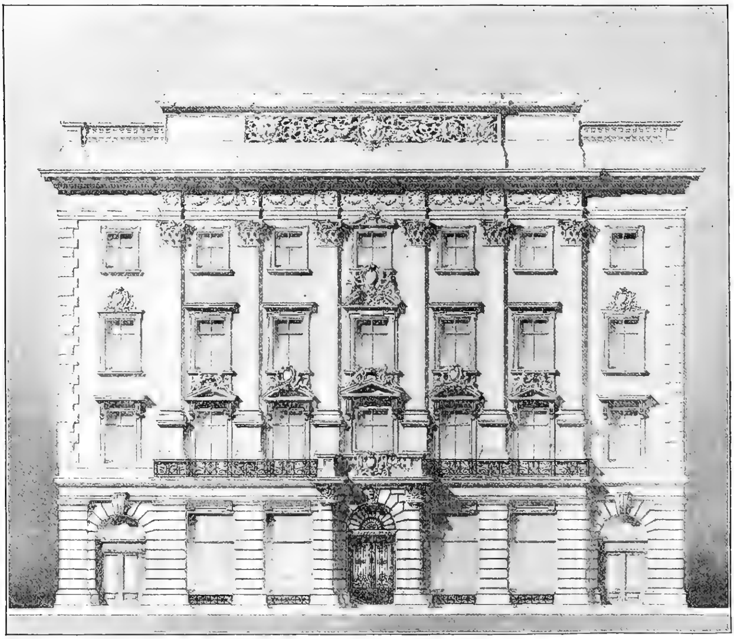
In June, 1895, the Council was incorporated by an Act of the Legislature of the State of New York, in which the objects were stated as follows: "To establish and maintain a scientific center in the City of New York, in which scientific societies can have their headquarters; to establish, accumulate, hold and administer a public library and a museum, having special reference to scientific subjects; to publish scientific works or periodicals; to give scientific instruction by lectures or otherwise, and to advance by appropriate means scientific discovery and the knowledge of scientific truth among the people; and to these ends to take and hold property as aforesaid; to erect or acquire, by deed, contract or otherwise, a suitable building, buildings, or part of a building, to contain such library and museum, and other rooms appropriate to the purposes aforesaid, and to the advancement of the scientific objects of the various societies represented in said corporation."

Early in 1896 the committee began to realize that the several plans which had been considered, for cooperation between the Alliance and other institutions, were not developing into tangible shape, and they therefore turned their attention to the original idea of a building exclusively for the use of the Alliance. To this they felt encouraged by the evidences then appearing that the general financial condition of the country was beginning to improve, and by the revival of public spirit and local pride manifested by many generous gifts and other practical aids bestowed upon various benevolent and educational enterprises by the citizens of New York. Accordingly, without relinquishing the lines of effort previously pursued, the committee began a quiet study of the broader problem and invited several well-known architects to make preliminary sketches of a building calculated to meet the needs of the allied societies and to come within a limit of cost for which it seemed possible that the Council might raise the money.

The first design submitted was by Mr. Geo. Martin Huss and was intended for a building entirely given up to the uses of the societies and consequently producing no revenue except from the occasional rental of its halls. The elevation was submitted to the Council at the meeting of May 21, 1896, and was adjudged to be dignified and impressive in style, but the question immediately arose as to the advisability of providing for office and store space in addition to lecture-halls and meeting-rooms in the building, and it was suggested to the committee to procure an alternative design embodying these features. Accordingly, at

the Council meeting of February 25, 1897, the committee submitted plans made by Mr. R. W. Gibson, and they were thoroughly discussed and referred back for certain modifications. Both the architects who have made sketches have performed a great deal of gratuitous labor on our behalf and are entitled to the gratitude of the Council. During the past summer Mr. Gibson has given particular attention to the development of our ideas and has patiently drawn and redrawn his designs several times.

The result is that we are now able to present an elevation and plans which seem to us as nearly ideal as they can be made without knowledge of the actual spot upon which the building is to stand and the amount of money that may be devoted to its erection. It is believed that the necessary land can be procured in a desirable location for not more than $200,000, and that the building can be erected of the best materials for about $300,000. The scheme supposes that the building will occupy four city lots, upon a corner, thus giving one hundred feet frontage on each street. This arrangement permits of ample entrances and exits as well as an abundance of side light. The first floor plan provides for two rentable offices or stores from which it may



SCIENTIFIC ALLIANCE BUILDING.
(From Design of R. W. Gibson, Architect.)

be possible to obtain sufficient income, in connection with rentals of lecture halls, etc., to pay the operating expenses of the building, thus entirely relieving the societies from any charges for their rooms, as, under our charter, the property will be exempt from taxation. The large auditorium is calculated to seat one thousand persons, and is approached by ample hallways directly from the street. The main feature of the second floor is a large parlor or club room, extending across the whole front of the building, which is intended to be a place of general rendezvous and social intercourse for the members of the societies. On this floor, however, there is also an assembly room which is to be for the common use of the societies for meetings that may be larger than can be accommodated in their separate apartments. When not so used it is to be available for public rental. On the second, third and fourth floors twelve society rooms and four laboratories are provided. Eight of the former will be assigned to the societies now included in the Alliance, and four will be reserved for societies that may be admitted hereafter. In the meantime they may be rented. The fifth floor is lighted largely from the roof and is devoted exclusively to the library and reading rooms, with double-tiered stacks for about 200,000 books.

It is not necessary to go into a minute description of these plans, as the drawings submitted herewith exhibit plainly the details, which have all been worked out with much care. We believe that every essential requirement has been met as fully as the limits of space will permit, and we are so well satisfied with the plans as a whole that we recommend that they be reproduced in suitable form for distribution to the members of the Alliance, and also that a considerable number be sent out to the public, accompanied by appropriate text, in the hope that interest may be awakened in the enterprise we have in hand, and with faith that the paper may come under the notice of some generous citizen who will be induced to at least inaugurate a movement for the happy realization of what is now but an earnest desire on our part.

The general financial improvement of which we have spoken not only has continued, but has gathered force during the past year, so that now many good judges of business matters confidently look forward to a period of substantial prosperity. If their anticipatious are well founded we may have before us the great opportunity for which we have long waited, to place before the public-spirited citizens of New York, with success, an appeal for the establishment of science upon a firm and enduring basis in this enlarged and aspiring metropolis. We feel confident that the time has come to put forth an earnest effort in this direction and trust that the Council will confirm our purpose and reinforce our endeavor by all the means that can be properly invoked for the cause.

ZOOLOGICAL NOTES.

DR. ALFRED SCHAPER has an interesting paper on 'The Influence of the Central Nervous System upon the Development of the Embryo' in the *Journal* of the Boston Society of Medical Sciences for January 18th. The animals experimented upon were the larvæ of frogs, and the aim of the experiment was to remove the entire central nervous system, or certain parts of it, by excision in very young larvæ where the neural tube had just closed, and then to try to keep the larvæ alive, observing the results of the operation on the course of development. The dorso-frontal portion of the head was cut off with a sharp lancet, removing in successful cases the entire brain, with the medulla, the anlage of the eyes, the olfactory and auditory organs.

Some of the larvæ lived, and developed

for seven days, their organs, other than those operated on, not only assuming their typical shape and correlative arrangement, but also undergoing typical histogenic differentiation. Dr. Schaper considers that his experiments corroborate the theories of Roux, who divides the development of an organism into an early period of organogenetic development and a later period of functional development. During the first period the organs develop by means of an inherited endogenous energy without influence from outer stimuli; during the second the gradually developed specific function of the individual organ, as well as the cooperative function of all the organs of the body, are the main stimuli for further growth. During this second period the absence of an important organ, and especially of the central nervous system, must be fatal and lead to the death of the organism.

Two investigators have recently used the Röntgen rays to very good purpose. The first of these, Professor H. C. Bumpus, was, by their aid, enabled to note accurately the number of vertebræ, and record the position of the pelvis in 100 specimens of *Necturus*. The other, Dr. W. C. Cannon, used the rays to obtain figures showing the changing shape of the stomach during digestion, using for the purpose a cat. The animal's food was mixed with subnitrate of bismuth and the wave-like movements of the pyloric portion of the stomach were made clearly visible. The total number of waves which passed over the antrum during the seven hours a cat was digesting a meal of soft bread was about 2,600.

Professor Bumpus's paper, alluded to above, can hardly be summarized, owing to the number of questions discussed and amount of evidence brought forward. It may, however, be said that in 36 out of 100 examples of *Necturus* the pelvis was abnormally attached, and that in 22 cases it was attached to the twentieth instead of the nineteenth vertebra. Variations in the relative position of the pelvic arch are associated with variations in the position of the pectoral arch; the definitive location of the pelvis is probably due to centripetal influence derived from the budding appendage, and intercalation of vertebræ in the sense of the introduction of new segments does not take place.

F. A. L.

CURRENT NOTES ON PHYSIOGRAPHY.

THE MISSISSIPPI FLOOD OF 1897.

WEATHER BUREAU BULLETIN E, 'Floods of the Mississippi River,' by Park Morrill, is a report on an important subject concerning which most persons have only newspaper information. Forty-five quarto pages are given to a general account of the river, its flood plain and some of its earlier floods. Thirty pages describe the spring flood of 1897. Many charts represent the normal monthly precipitation of the region, certain cases of exceptional precipitation, and records of hydrographs during floods at various stations. Among the most interesting plates is one (based on the Mississippi River Commission map) representing the flooded area of 1897 and its relation to the 'alluvial valley' or flood plain of the lower Mississippi. The manner in which the flood avoided the higher ground along the river and selected the back swamps at one or the other side of the flood plain is very clearly brought out. As is well known, the great river follows near the eastern bluffs as far as Memphis, then swings across to the western bluffs at Helena, and returns to the eastern bluffs at Vicksburg, remaining close to them as far as Baton Rouge. The flood began in the St. Francis basin, west of the river, in the Memphis section. It crossed the river near Helena, submerging the lower Yazoo basin, but leaving the upper Yazoo basin free. The flood again crossed the river near Vicksburg, submerging the lower Macon basin, but

leaving the upper basin free. Thence to the Gulf it followed the western back swamps, the main river not overflowing below Vicksburg. The safety of the upper Yazoo basin resulted not alone from the high ground along the Mississippi, but also from the belt of high unfloodable ground that divides the upper Yazoo and the Sunflower basins. This belt is mentioned in the text as an extension of Crowley's ridge (on the west side of the Mississippi, above Helena). It is truly in line with Crowley's ridge, but the two are probably of altogether different origins. Crowley's ridge is an isolated part of the uplands that border the flood plain on the west (see SCIENCE, I., 1895, 605); but the unfloodable belt between the Yazoo and the Sunflower probably marks a former aggraded path of the Mississippi, deserted at the time of some ancient flood.

THE FIJI CORAL REEFS.

A LETTER from Alexander Agassiz, on 'The Islands and Coral Reefs of the Fiji Group' (*Amer. Journ. Sci.*, V., 1898, 113–123), presents matter of much importance in connection with theories of reef formation. Instead of finding, as was expected from the accounts by Darwin and Dana, that a progressive subsidence would account for the barrier reefs of the Fiji group, numerous elevated reefs were seen at heights of 600 to 800 feet; and a number of barrier reefs and atolls were discovered to be only the denuded remnants of reefs formerly elevated. Boring into the reefs was regarded as unnecessary, for the natural sections exposed by the elevated reefs revealed their structure clearly. While the elevated reef deposits may have been formed during a period of subsidence, that movement cannot be included in the present geological period, nor can it account for the existing distribution of reefs at sea-level, where recent coral growth is thought to have added only a relatively thin crust to a pre-existent mass. A possible relation of circular or oval atolls to a foundation upon the worn-down rim of a large volcanic crater (caldera) is suggested; calderas being of frequent occurrence, and having outlines and dimensions similar to those of reefs near by.

The separation of the smaller volcanic islands from the larger ones in the Fiji group is taken as evidence of long continued denudation, largely by the sea, after the uplift of the region. The possibility of some of this separation being due to subsidence is not explicitly considered. The importance of subsidence in the formation of reef deposits may still be maintained, but in the Fiji group it seems to have little bearing on present reef outlines.

THE MAZAMAS.

THE Mazamas, a society of practical mountaineers organized on the summit of Mt. Hood, in July, 1894, hold their annual meetings on mountain tops and publish their proceedings in '*Mazama*, a record of mountaineering in the Pacific Northwest' (Portland, Oregon); numbers for 1896 and 1897 having been issued. The second is the Crater Lake number, which gives a most enjoyable account of the gathering there in 1896, already noted in SCIENCE (June 18, 1897). Essays on the discovery, geography, geology, botany, zoology and bibliography of Crater Lake, with many illustrations from photographs, make this number of high value, deserving of earlier mention than in this belated note.

W. M. DAVIS.

CURRENT NOTES ON METEOROLOGY.

METEOROLOGICAL OBSERVATIONS DURING THE ECLIPSE OF JANUARY 22.

THE meteorological observations made at Viziadurg during the eclipse of January 22d, as noted by Mr. J. Eliot, Meteorological Reporter to the Government of India,

in *Nature* for February 17th, were much less striking than was anticipated. The influence of the eclipse on the barometer was either nil or so small that a careful study of the tracings will be necessary in order to detect it. The temperature rose more slowly than usual from 11 a. m. until about totality, when it fell rapidly about 5° F., and was constant for some time after totality, but the fall in temperature was partly at first due to the usual change from land winds to sea breezes, which usually takes place at noon. The solar radiation thermometer was the only instrument which showed any considerable influence due to the solar eclipse. This thermometer rose steadily from sunrise until about five minutes after the commencement (*i. e.*, 11:15 a. m.), when it read 144°. It fell continuously and with increasing rapidity until the end of totality, when it registered 81.5°,=practically the temperature of the air. During the latter part of this period it fell at the rate of upwards of 4° in five minutes.

HANN'S KLIMATOLOGIE.

THE publication of a second edition of Hann's *Klimatologie* emphasizes anew the urgent need that exists for a standard work on climatology in the English language. At present there is no book of the kind in English, and indeed there is little likelihood that anyone will attempt such a work, since Dr. Hann has so thoroughly and so masterfully presented the subject, on which he is the acknowledged authority the world over. The rapidly growing interest in meteorology and climatology in the universities and schools of the United States makes an English text-book very desirable, if not essential, and it must be the hope of American teachers and students of these two branches of science that an English translation of the new edition of Hann's work will not long be delayed.

BAROMETRICAL DETERMINATION OF HEIGHTS.

THE 'Barometrical Determination of Heights' is the title of a neat little book of 28 pages by Dr. F. J. B. Cordeiro, of the United States Navy. The essay was originally written in competition for the Hodgkins Fund prize (the preface has it *Hodgkin*), offered by the Smithsonian Institution. The problem of barometrical hypsometry is reviewed, and a new formula is proposed which, the author states, 'is rigidly accurate in theory and which in practice will give reliable results under all conditions.'

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CURRENT NOTES ON ANTHROPOLOGY.

THE ABORIGENES OF WESTERN ASIA.

FEW localities on the globe have greater historic interest than Asia Minor and Syria; and the traits of the oldest inhabitants of those regions have, therefore, some special importance. The subject was discussed before the anthropological section of the International Medical Congress, at Moscow, last August, with an abundant difference of opinion. Professor Sergi maintained that the most ancient skull-form found there was markedly dolichocephalic; while Dr. von Luschan asserted that it was 'hypsibrachicephalic,' the purest modern examples of which are among the Armenians. Professor Virchow disagreed with von Luschan, and the fact, generally acknowledged, that the Armenians, who are a branch of the Aryan family, were immigrants into Asia Minor, seems to be in conflict with their identification with the primitive settlers.

ETHNOLOGICAL STUDY OF CULTIVATED PLANTS.

AT the last meeting of the German Anthropological Society, Dr. Hahn read a paper on cultivated plants in reference to ethnology. It is a significant fact that the Australians, before the discovery, did not

cultivate a single food plant anywhere over their vast area; but it is nearly paralleled by North America (north of Central America), where not a single indigenous plant was cultivated except perhaps the sunflower (maize was from Central America). Central and South America could show maize, manioc, tomatoes, potatoes, beans, cacao, tobacco, yams, etc. Africa was the home of the durra and probably of coffee, though the latter seems to have been cultivated first in Arabia. Cereals were the staples of western Europe and Asia from the earliest times, as rice was of eastern Asia. The influence which the culture of these articles of food exercised on the daily life and thoughts of early tribes was profound, as is witnessed by their mythology and laws.

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ASTROPHYSICAL NOTES.

IN *Circular No. 19* of the Harvard College Observatory Professor E. C. Pickering announces the results of the examination of the spectra of stars in the large Magellanic cloud on plates taken with the Bruce photographic telescope at the Arequipa station. Six stars in this region, in Right Ascension about 5h. 30m. and South Declination about 69°, are found to have spectra of the fifth type ('Wolf-Rayet' type; Vogel's II*b*), consisting largely of bright lines. The position of these stars is unusual, as they lie over thirty degrees from the Milky Way, while all the stars of this class previously discovered, sixty-seven in number, have the remarkable peculiarity of being situated very near the central line of the Milky Way, their galactic latitude on the average being less than 3°.

In the same region seven stars were found whose spectra are of the first type, but with bright hydrogen lines. The number of known stars with this variety of spectrum has been greatly increased in the past few years in the progress of the Henry Draper memorial.

Circular No. 21 states that the bright hydrogen line $H\beta$, discovered in the spectrum of the southern star No. 9181 of the Argentine General Catalogue in 1895, appears to be variable in that star. It was bright in October, 1897, but invisible on December 27th. Announcement is also made that Mrs. Fleming finds, on examination of Draper memorial plates, that β Lupi is a spectroscopic binary, with a period not yet determined. The approximate relative velocities of the recently discovered spectroscopic binaries μ^1 Scorpii and *A. G. C.*, No. 10,534, are given as 460 and 610 kilometers per second, respectively.

Circulars Nos. 22, 23, 24 and *25* refer chiefly to matters of visual and photographic photometry. From a comparison of the constancy of the comparison stars used in determining the variations of over sixty variables found by Professor Bailey in the cluster Messier 5, it appears that any errors due to irregularity in the sensitiveness of the film on a plate are too small to be detected with certainty. The average deviation of five comparison stars on 35 plates, involving over four thousand estimates of brightness, was but 0.02 magnitude, which includes the errors of observation and those from neglecting hundredths of a magnitude in the individual estimates.

By the addition of a second double-image prism to the polarizing photometer long in use at Harvard, so as to produce coincidence of the emergent pencils from the two stars compared, the previously high accuracy of the observations has been increased. Eight measures, by Mr. O. C. Wendell, of the difference in brightness of two stars on a recent evening gave the singular and unusual degree of accordance of all the measures within 0.01 magnitude.

From a series of measures, by Wendell, of the brightness of the short period variable,

U Pegasi, Pickering concludes that the star exhibits a principal and secondary minimum, at magnitudes 9.90 and 9.75 respectively, in a period of nine hours. Chandler, however (*Astronomical Journal*, XVIII., p. 140), regards this difference between the minima too slight to be conclusive, and derives from his own observations (with the omission of his first estimates by which he discovered the star's variability) a simple, symmetrical light curve, with a period of four and one-half hours.

The number of variables in star clusters discovered by Bailey on the Harvard plates has been increased by his further study of them, so that now the clusters ω Centauri, Messier 3, Messier 5 and N. G. C. 7078 have been found to contain, respectively, 122, 132, 85 and 51 variable stars, or 390 in all.

E. B. F.

NOTES ON INORGANIC CHEMISTRY.

SOME weeks since attention was called in these notes to the formation of ammonium peroxid, or rather a compound of ammonium peroxid and hydrogen peroxid, by P. Melikoff and L. Pissarjewsky at the University of Odessa. To this compound, which is formed by the action of ethereal solution of ammonia upon a similar solution of hydrogen peroxid, the formula $(NH_4)_2O_2$, $2H_2O_2$,$10H_2O$ was given. An article in the last *Berichte* gives further particulars of the compound and assigns the formula $(NH_4)_2O_2,H_2O_2,H_2O$. The water is considered as water of crystallization, and is apparently not constant, as in one specimen the water present corresponded to $(NH_4)_2O_2,H_2O_2,\frac{1}{2}H_2O$. It is possible, however, to consider the substance as NH_4O_2H, the peroxid of ammonium hydroxid. From the relative stability of ozone and hydrogen peroxid it is not improbable that their constitutional formulæ should be written $O{=}O^{iv}{=}O$ and $\genfrac{}{}{0pt}{}{H}{H}{>}O^{iv}{=}O$, one atom of oxygen being considered quadrivalent. If this be the case, the formula of ammonium peroxid might be $\genfrac{}{}{0pt}{}{NH_4}{H}{>}O^{iv}{=}O$.

IN the same *Berichte* account is given of some new compounds in which a part of the oxygen in sulfates and phosphates is replaced by fluorin. Types of these compounds are $HK_3S_2O_7Fl_2,H_2O$ and HRb,PO_3Fl,H_2O. These interesting substances are fairly stable and are closely related to the fluoriodates, not long since discovered by Professor Weinland, to whom we are also indebted for these fluosulfates and fluorphosphates.

AT the last meeting of the Chemical Society (London) a paper was read by W. A. Shenstone and Beck, on the influence of the silent discharge of electricity on atmospheric air. At first there is a large contraction and this is followed by a re-expansion to nearly the original volume, and a trace of nitrogen peroxid is present.

The explanation offered is that at first the oxygen in the air is condensed to ozone. In air it appears that owing to dilution with an inert gas, nitrogen, from 80 % to 90 % of the oxygen can be converted into ozone. This causes the first contraction. When the oxygen is almost completely changed into ozone some small amounto nitrogen dioxid is formed. This at once attacks the ozone molecule and breaks it down under the influence of the silent discharge, and the gas returns to its original volume. As confirmatory of this theory is the fact that not a trace of ozone can be made in the presence of nitrogen peroxid.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE ALLEGHENY OBSERVATORY.

PROFESSOR JAMES E. KEELER has written a letter to the Chairman of the Observatory Committee stating that he is prepared to decline the call to the Directorship of the Lick Obser-

vatory if within two weeks $200,000 can be collected for the erection of a new observatory and for other purposes. The Trustees have adopted the following resolutions:

"WHEREAS, The Board of Trustees of the Western University has received a communication from Professor James E. Keeler, Director of the Allegheny Observatory, announcing his election to the Directorship of the Lick Observatory, it is

"*Resolved*, That we place upon record our mingled feelings of pride and regret; pride because he has been chosen to fill the highest position in the astronomical world, because the choice has fallen upon one whom we love and honor as a friend, and whose career was begun in connection with this institution, and who during his more recent connection with it as its Director has shed upon it the luster of brilliant scientific discoveries; regret because this election, so honorable to him, if accepted, will terminate the relations which have been to us a source of profound satisfaction and pleasure.

"*Resolved*, That the intimation which he gives to us, that if we shall secure within the next two weeks the sum of money necessary to place our observatory in a position which will make it worthy of its past illustrious history, and of the great community in which it is located, he will remain with us, fills us with hope, and we pledge ourselves to endeavor by all the means at our command to secure this result.

"*Resolved*, That to this end we call upon all those in this community who have civic pride and an interest in the promotion and advancement of knowledge to aid us in this effort to secure the sum of $200,000, which, in the judgment of this Board, is necessary in order to build and equip a new observatory and to provide a sum sufficient to complete the endowment of the chair of astronomy.

"*Resolved*, That we record with grateful appreciation the kind response that has already been made by our fellow-citizens, who have thus far subscribed to this cause the sum of $137,000.

"Be it further *Resolved*, That a committee, consisting of the President of the Board, Dr. John Krockar White; Mr. John A. Brashear, Chairman of the Observatory Committee, and the Chancellor, Dr. W. J. Holland, be appointed to present to the public, through the columns of the press, the urgent need which exists for immediate action, and to appeal to all liberally disposed persons to aid us by their contributions, whether large or small, so that the high standing of the Allegheny Observatory, which has heretofore occupied the foremost place among like institutions in this country, may be still maintained, and that it may be restored to the rank which it deserves to hold, but which it has in part lost through its meager endowment, and through the encroachment of manufacturing industries in its immediate neighborhood."

GENERAL.

THE British Association for the Advancement of Science will be invited to meet at Bradford in 1900.

THE German Zoological Society will hold its eighth annual session at Heidelberg from the first to the third of June under the presidency of Professor T. E. Schulze. In addition to papers and demonstrations, reports will be presented from the editor of *Das Thierreich* and from the delegate to the International Commission on Nomenclature. Professor J. W. Spengel (Giessen) has been elected Secretary of the Society.

THE twelfth annual meeting of the German Anatomical Society will be held at Kiel from the 17th to the 20th of April.

THE Scientific Alliance of New York gave a dinner at the Hotel Savoy on March 16th, with about 170 guests in attendance. Mr. Charles F. Cox, President of the Council of the Alliance, presided. The scientific program was as follows:

Science as a Moral Force: CHANCELLOR H. M. MACCRACKEN.

Science in Education: HON. SETH LOW.

Science, the Nation's Safeguard: PROFESSOR SIMON NEWCOMB.

The City's Debt to Science: PROFESSOR J. J. STEVENSON.

Science and Commerce: HON. WM. E. DODGE.

The Interest of Sister Cities in the Science of New York: PROFESSOR GEO. F. BARKER.

Science for the People: Professor Henry F. Osborn.

Science in Warfare: Capt. E. L. Zalinski.

Reference was made in the speeches to the debt of New York City to science, and the hope was expressed that the city would in return give the societies a building for their meetings and for the establishment of a scientific center in the city. The report of the building committee of the Alliance will be found elsewhere in this issue of Science.

The National Geographic Society held its annual reception in the Corcoran Art Gallery on March 16th. President Alexander Graham Bell and the following members of the Board of Managers received the guests: Messrs. F. V. Coville, W. H. Dall, David T. Day, Henry Gannett, G. K. Gilbert, A. W. Greely, John Hyde, W J McGee, C. Hart Merriam, H. G. Ogden and Miss E. R. Scidmore. These were assisted by Miss E. M. Bell, Mrs. Dall, Mrs. Coville, Mrs. McGee, Mrs. Gilbert, Mrs. H. F. Blount, Mrs. Day, Mrs. Gannett, Mrs. Greely, Mrs. Hyde, Mrs. Merriam and Mrs. Ogden.

Dr. B. H. Warren, the State Zoologist of Pennsylvania, has tendered his resignation to Secretary Edge, of the Board of Agriculture. Dr. Warren, according to the Philadelphia *Ledger*, says in his letter: "Governor D. H. Hastings, on the day of his departure for the Pacific coast, directed a mutual friend to interview me and request that I should support the Anti-McCauley delegates to the State Convention. This I positively declined to do." After further brief discussion of his position as a supporter of the McCauley-Quay interests, Dr. Warren closes his letter, after expressing thanks to Governor Hastings and Secretary Edge for courtesies extended, as follows: "As my attitude seems to be at variance with what Governor Hastings desires, and as I believe he should be surrounded with officials who will be in full accord with his political views, I to-day sever my official connection with your Department, and shall esteem it a favor if you will kindly, at your earliest convenience, communicate this to the Governor." The attitude of Governor Hastings in regard to the State Zoologist appears to be most unfortunate, but we cannot greatly regret the resignation of a State Zoologist who believes that he should be in 'full accord with the political views' of the Governor.

Professor Grimaux, member of the Paris Academy, has been deprived of his chair in the École Polytechnique, Paris, owing to his testimony at the trial of M. Zola. We learn from *The British Medical Journal* that at a recent meeting of the Biological Society the assembled members (numbering 40) decided to express to Professor Grimaux their sympathy and esteem for him. When Professor Grimaux appeared at the meeting all present rose, and Professor Richet made the following speech: "It is the custom at the Biological Society to congratulate its members when an honor is conferred on them, or when a memorable event occurs in their career. To-day we offer the homage of our affection to M. Grimaux, our master, our friend and our colleague. He has been severely treated. It is not for us to criticise this act, but we desire to express to him the admiration, the respect and sympathy which animate the hearts of us all." M. Grimaux, who was considerably affected by this expression of sympathy, replied: "Certainly the law has been violated. Witnesses who give evidence according to their conscience should be protected. I repeat, I listened only to the dictates of my conscience. I swore to tell the truth and I told it. I am prepared always to do my duty in the same way."

Dr. Th. W. Engelmann has been elected a member of the Berlin Academy of Sciences.

The Belgian Academy of Sciences has elected as foreign members: Professors F. Klein, Göttingen; G. Salmon, Dublin; E. Haeckel, Jena; J. B. A. Chauveau, Paris; W. Pfeffer, Leipzig, and A. de Lapparent, Paris.

Professor W. Pfeffer, whose great work on *Pflanzenphysiologie* was reviewed in a recent number of this Journal, was invited to give the Croonian lectures before the Royal Society on March 17th. Cambridge University will confer upon him the degree of Doctor of Science.

We learn from *Nature* that more that 100 foreign zoologists have now consented to be mem-

bers of the 'Committee of Patronage' of the Fourth International Congress of Zoology, and a large number of them have expressed the hope that they will be able to be present at the meeting in August next. Among these may be mentioned the names of Professor Häckel, of Jena; Professor Graff, of Graz; Professor Grassi, of Rome; M. Blanchard, of Paris; Baron Jules de Guerne, who has been associated with the Prince of Monaco; Dr. Jentink, of Leyden, who was President of the Third Congress; Dr. Dollo, of Brussels; and Professor Collett, of Christiania. From the United States it is expected that there will be a somewhat large contingent, including Professors Osborn, Scott, Wilson and Watasé.

IT is proposed to erect, by international subscription, a monument to Buysballot, the eminent Dutch meteorologist, who died in 1890. Subscriptions may be sent to Dr. Mauritz Snellen, Director of the Meteorological Institute, Bilt, near Utrecht.

JOSÉ D' ANCHIETÁ, a zoologist who has made important collections and observations in the Portugese African possessions, died in Caconda (Angola), on September 14th last, at the age of 66 years. J. Hoyes Panton, professor of biology and geology at the Ontario Agricultural College, Canada, died at Ontario on March 2d.

Two generous benefactors of educational institutions have died during the week, Mr. Jacob Tome, who endowed the Jacob Tome Institute, at Port Deposit, Md., with $2,000,000, and Mr. Thomas McKean, who gave the University of Pennsylvania sums aggregating $300,000.

THE Academy of Medicine, Paris, has awarded the Monbinne prize of $300 to Dr. Huguet, army surgeon, to enable him to continue his scientific mission for exploring Mount Zab.

DR. CARL LUMHOLTZ and Dr. A. Hrdlicka have left New York for Mexico to study the Mexican Indians and antiquities.

REUTER'S Agency is informed that the plans have been formed by Major Gibbons for the forthcoming expedition through Africa from south to north. The primary object of the journey is the continuation of the valuable geographical work already accomplished by the explorer on the Zambesi, after which it is hoped to continue the journey *via* the Great Lakes to the Nile, and thence, if the political situation then permits, down that river to Cairo, thereby accomplishing a through journey from Cape Town to Cairo, or, failing that, to reach the West Coast *via* the Congo. An interesting feature of the expedition is the employment of specially constructed aluminium launches and barges, which can be taken to pieces and put together again, thus enabling the expedition to be divided into as many as four sections. In addition to a grant from the Royal Geographical Society, Major Gibbons is receiving support from certain government departments, for whom he will do special work. Major Gibbons hopes to make the whole journey in about 18 months.

THE Zurich correspondent of the London *Times* writes that the observatory of Mont Blanc, which was constructed by M. Joseph Vallot some seven years ago, is to be transferred to another site. The present structure is built on a small rocky plateau, which extends for a short distance from the Rochers des Bosses, but its position is no longer favorable for scientific observations. The construction of the building has served as a barrier against which the snow piles itself in ever-increasing masses, causing both trouble and expense to the observatory staff. The whole erection is to be transferred, piece by piece, on the backs of workmen from the Rochers des Bosses to a rocky point at the same altitude, where the ground will first be levelled by blasting, and, in spite of the difficulties of climate and transport attending these operations, it is hoped that the whole transfer will be finished in the course of one summer season.

THE Russian Society of Geography proposes to establish a meteorological station on Elbrouz, in the Caucasus, at an altitude 5,636 meters.

MR. CARNEGIE has given $10,000 to the Carnegie Library, Pittsburg, for the purchase of scientific books.

WE have already announced the fact that the American Women's Committee have succeeded in securing subscriptions for a table for women at

the Zoological Station at Naples. Efforts are now being made to collect a second sum of $500 for the expenses of the holder of the table. Four subscriptions of $50 have been received, the subscribers being: Bryn Mawr College, Sage College of Cornell University, the women students of Brown University and Miss L. V. Sampson.

THE House of Representatives has agreed to the conference report on the Legislative, Executive and Judicial Appropriation Bill. As passed, it provides for a new division for the Patent Office and the opening of the Library of Congress at night after October 1st next.

AN exhibition of the Durr Light was given, on Wednesday, the 23d inst., from 7 to 9 p. m., in the Court of the Library Building, Columbia University. The light is generated by automatic evaporation and superheating of vapors of ordinary kerosene, without employing compressed air, and is odorless and smokeless. Lamps of 1,500 and 3,500 candle-power were used.

THE German Balneological Society held its ninth public meeting on March 11th and following days in Berlin, under the presidency of Professor Liebreich, who delivered the opening address. Among the communications were: 'The Question of Contagiousness of Tuberculosis,' by Dr. Römpler, of Görbersdorf; the 'Effect of the so-called Indifferent Mineral Waters,' by Professor Liebreich; the 'Hydrotherapy of Simple Ulcer of the Stomach,' by Professor Winternitz, of Vienna, and 'Vegetable Diet Cures,' by Dr. Strosser, of Vienna.

THE fourth Congress for the Study of Tuberculosis will be held at Paris from the 27th of July to the 2d of August, under the presidency of M. Noccard.

THE annual spring exhibition of the Massachusetts Horticultural Society will be held at Horticultural Hall, 101 Tremont street, opening on March 22d, and lasting four days. Prizes to the amount of eleven hundred and thirty dollars will be awarded.

A COMMITTEE of the American Chemical Society consisting of E. E. Ewell, Chairman, Washington, D. C.; G. E. Barton, Millville, N. J.; C. E. Linebarger, Chicago, Ill.; F. P. Venable, Chapel Hill, N, C., and L. P. Kinnicutt, Worcester, Mass., has been appointed to study and report upon the means by which the Society can hasten the adoption of uniform systems of graduation, definite limits of accuracy and standard methods for using all forms of measuring instruments in use in chemical laboratories. Further the committee has been instructed to cooperate with other scientific bodies which have already undertaken this work, or which may enter upon it in the future.

THE *Revue des Revues* contains an illustrated account of the laboratory of physiological psychology at the Sorbonne, under the auspices of the École des Hautes-Études, directed by M. Binet. It appears from the article that in addition to the laboratories at Paris there are laboratories at Rennes, Louvain, Liège and Geneva.

THE public libraries division of the University of the State of New York, following recent precedent, has issued a list of '500 leading books,' selected from the 4,928 published in 1897. This list was submitted to the librarians of the State, to 'obtain an expression of opinion respecting the best 500 books of 1897 for a village library.' The result of 157 replies shows, as might be expected, that the favorite books are novels. Five books on natural science were indeed included, but confined to the popular study of birds and insects.

AT a meeting of the Zoological Society of London on February 15th Mr. G. A. Boulenger, F. R. S., described a new species of Sea-snake from Borneo, which he proposed to name *Hydrophis flowri*, after Mr. Stanley Flower, its discoverer. Mr. Boulenger also gave an account of the Reptiles and Batrachians lately collected by Mr. W. F. H. Rosenberg in western Ecuador. Seventy-seven species were enumerated, of which twenty-three, viz.: eleven Reptiles and twelve Batrachians, were described as new.

THE London Local Government Board has given orders that the new form of vaccine mixed with glycerine is to be served out to all vaccination officers following upon the recommendations of the Special Commission on Vaccination, which recently examined all the

great vaccination departments of foreign governments. This is to be undertaken at once without regard to the vaccination legislation promised in the Queen's Speech, and will be completely independent of such a measure. Some delay has arisen in sending out the new lymph, owing to the want of a special laboratory for the cultivation of the matter, but this will not now be long delayed, as soon as the Local Government Medical Board is granted funds to purchase or secure a laboratory.

IT is stated in *Industries and Iron* that Herr Wachnitz, a German engineer, has succeeded in plating aluminium with copper by a welding process. It is stated that the plated sheets can easily be soldered, grooved, tinned and nickeled. The plating may be of any thickness desired, and even with the thinnest sheets there is no separation when rolled or drawn. Large sample sheets have already been submitted to the inspection of the Imperial Navy Department and other large manufacturing concerns. The obstacles to a still wider use of aluminium, which could be expected in view of its great lightness, have been its poor ability to solder, its weak power of resistance to numerous fluids, and the further fact that paint does not adhere to it very well. All these objections would be removed by this invention.

PROFESSOR NERNST, of Göttingen, has made an important improvement in the efficiency of the incandescent light, the first authentic account of it that we have noticed being contributed to the *Electrical World* by Dr. H. Lux, editor of the *Zeitschrift für Beleuchtungswesen*. Dr. Lux explains that as long as carbon filaments are used in incandescent lights the efficiency of the system will probably not be much increased. Professor Nernst uses the so-called conductors of second class, such as chalk, magnesia and kaolin, materials that, when cold, have an extremely high resistance to the current, so high indeed that they might be called insulators, the resistance falling greatly at high temperatures. These materials are notable for the large proportion of visible light rays in their radiation. The lime light and the Welsbach incandescent gaslight are notable instances of the application of this principle. As Professor Nernst says in a letter, these materials have a higher emission of light, as they are not in the sense of Kirchhoff absolutely 'black substances.' If these materials are raised to a sufficiently high temperature, no matter by what means, the efficiency of production of light is remarkably high. Professor Nernst applies as the means to bring the bodies to a high temperature the electric current, conducting it by small staffs of magnesia, chalk or other materials, after having prepared them to conduct the current by warming them. It is necessary to work with alternating currents to avoid electrolytic action on the material employed. The importance of this invention, if it can be practically employed—Professor Nernst, a true scientific man, advises us not to be too hopeful—would be very great, as the cost of incandescent lighting would be reduced to about one-third of the present rate.

UNIVERSITY AND EDUCATIONAL NEWS.

THE bill before the Maryland Legislature for an annual appropriation of $100,000 to the Johns Hopkins University was reported unfavorably on March 16th by the Committee on Ways and Means, and the House, by a vote of 50 to 17, refused to substitute the bill for the unfavorable report. The Senate is, however, more favorably disposed to the bill, and it is possible that a compromise may be effected by which at least part of the appropriation may be made.

THE eighth annual report of President Low, of Columbia University, presented to the Trustees on October 4th, has been published, together with the reports of the Deans of the various schools, of the Librarian and of the Treasurer. President Low takes the removal to the new site as the occasion for comparing the present condition of the University with that of the College when in 1857 it moved to 49th Street, and when in 1889–90 he was installed as President. In 1847 there were 14 members of the Faculty; in 1890 there were 176 officers of instruction, while there were 289 in 1897. The receipts of the University for current expenses were about $775,000 and the excess of disbursements over receipts was about $34,000. The average annual increase in the

library during the last five years has been over 19,000 volumes.

THE Teachers' College, Columbia University, has received from an anonymous donor a gift of $40,000. Three other gifts of $25,000 each have been received since December 1st.

THE Missouri Supreme Court, in an opinion by Justice Gante, on March 16th, declared the Missouri State University Free Scholarship Law unconstitutional. This law provided for the collection of a special tax on corporations and on patent medicine and a collateral tax of inheritance to establish free scholarships in the State University.

CONVOCATION week at the University of Chicago begins on Friday, April 1st. The President will make the quarterly report and the convocation address will be given by Professor William Knight, of St. Andrews University, his subject being 'Poetry and Science: Their Affinities and Contrasts.'

DR. CHARLES R. BARNES, of the University of Wisconsin, has been appointed professor of plant physiology in the University of Chicago.

PROFESSOR GATES, of Amherst College, has been given a year's leave of absence by the Trustees.

A BERLIN despatch states that a decree has been issued by the government forbidding the future attendance of foreigners in the machinery and engineering department of the Berlin Technical High School.

A UNIVERSITY EXTENSION meeting will be held in London from May 30th to June 11th. The program, which should be of interest to Americans visiting London, includes lectures by Sir John Evans, on 'London before the Saxons'; by Professor Skeat, on 'Chaucer's London'; and by Mr. Gollancz, on 'Shakespeare and the London Theatre.' Mr. Owen Seamen will give three lectures on 'The London Poets,' Mr. Mackinder two on 'The Geography of London,' and Mr. Arnold Mitchell three on 'London Architecture,' followed by a demonstration in the Church of St. Bartholomew, Smithfield. In the Education Section, Sir Joshua Fitch will deal with 'The National Portrait Gallery and its Educational Uses,' Professor Miall with 'The Curiosity of Children,' and Mr. Marriott with 'John Colet, the Founder of St. Paul's School.' A course of three lectures entitled 'Studies on Children' will be delivered by Mr. Earl Barnes, late professor of pedagogy in the Leland Stanford Junior University.

MR. HENRY HANNA, M.A., B.Sc., has been appointed demonstrator of biology, geology, and paleontology in the Royal College of Science, Dublin.

MR. J. G. KERR, a student of zoology, has been elected a fellow in Christ's College, Cambridge.

DISCUSSION AND CORRESPONDENCE.

THE TERMINOLOGY OF THE NEUROCYTE OR NERVE CELL.

THE writer is far from being one that regards the introduction of new terms, even where they seem to shorten a phrase or so, as necessarily an advance in science. But it seems as though some improvements might be made in the terminology of the neurocyte, not only in the use of terms already suggested and more or less employed, but also by suggesting at least two more. The varying senses in which some terms in use are employed and the different terms applied to the same thing are very confusing. Uni-, bi- and multi-polar cells one finds, for instance, according to the author read mean cells with one, two or more processes irrespective of whether they are recipient or discharging processes as regards the neural impulses that traverse them, or one finds that they mean cells with one, two or more discharging processes, axis cylinders or neurites irrespective of there being other processes. One finds the entire nerve cell spoken of as the nerve cell, neuron and as neurocyte; while that process, the main function of which appears to be that of bearing the neural impulse away from the cell body, or cell, when this is not to one side of the most direct course of the neural impulse, as is the case in the cells of the mammalian spinal ganglia and in all cases among the arthropods, is called the axiscylinder, axon, neuron and neurite. The other processes have been known as the protoplasmic processes or the dendrites.

Happily there is already a tendency to drop many of these synonyms. Let it be hoped in favor of neurocyte, neurite and dendrite, as being the least cumbersome and more in harmony with other words denoting a part, as, somite, sternite, tergite, phagocyte, etc., or as already, as in the case of neurocyte, having been thought by good authority sufficiently common to be given a place in popular dictionaries.

This terminology, however, seems to be insufficient for the needs of the study of the arthropod nervous system, where the part of the neurocyte containing the nucleus is situated on the outside of the nervous system and connected with the branching portions of the neurocyte by a stalk or process of greater or less length. It has always seemed misleading and more or less cumbersome to speak of this portion as the nerve cell, the cell, or the cell body. For this reason it appears that, to be in harmony with the other terms noted, that part of the neurocyte that in the older literature is called the nerve cell should be denominated the neurocyto-somite, or, more briefly, cytosomite. Such a term will not be misleading, nor, since it is a compound of frequently used particles, will it be difficult to retain.

In writing or speaking of the process just mentioned originating from an arthropod or spinal ganglion cell it has frequently seemed as though time and energy might be economized by giving this also a distinctive name. Instead of referring to a process from a neurocyte, neurocytic process, or a bundle of processes from such and such cells, it would be much better to use the word neurocytocaulite, or, briefly, caulite, which, along with cytosomite, is here suggested. It matters little whether some one may be able to show that caulite has, as seems probable, been used before in connection with some other subject, for it denotes a part, and the context in which it is used will prevent misconception. Should, however, a possibility of misconception arise, the difficulty may be readily overcome by using the form cytocaulite.

Summarizing the foregoing, the following morphological definition may be given a neurocyte: A cellular element of the nervous system, consisting of a cytosomite containing the nucleus and, with or without a caulite connecting it with the remainder of the neurocyte, with a neurite or neurites, performing the one neural function of discharging neural impulses, and with a dendrite or dendrites functioning usually as the recipients, sometimes, also, as dischargers of neural impulses.

F. C. KENYON.
U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

RETINAL IMAGES AND BINOCULAR VISION.

IN SCIENCE of March 11th Professor Stevens added some valuable observations to the facts reported by me in an earlier (February 25th) issue. He has objected to my title 'Binocular Factors in Monocular Vision' on the ground that "the essential characteristic of binocular vision consists in the simultaneous formation of slightly dissimilar images on the two retinas, with corresponding modification of the perception of depth in space." The criticism is more than a merely verbal one and the facts reported assume entirely different aspects as the one position or the other is taken.

It is doubtless true that complete perception of objects depends in large measure on the presence of such slightly different images on the two retinas. But it is also true that even in such cases of complete perception there are sensation factors derived from the movements of both the external muscles of the eyes and the internal ciliary muscles. When the retinal image of one eye is withdrawn, does it follow that these other factors are also withdrawn? Evidently not. On the contrary, there is good reason to believe that so-called monocular vision is complicated by the presence of muscle-sensations from the closed eye. The first question to be raised and answered, then, is the question of the character of the movements which are the sources of these sensations. This was the question taken up in the first paper. Its results were applied directly to the solution of the main problem, namely, what are the binocular factors in so-called monocular vision? The double images, which are, as Professor Stevens very properly points out, monocular phenomena, were made use of in this experiment merely for the purpose of dis-

covering the position of the closed eye. The various cases tested by the method described led to the conclusion 'that the closed eye follows the open eye to a certain extent, and to a certain extent obeys its own tendencies of relaxation.' These facts, together with the changes in accommodation pointed out, may be made use of to explain some of the differences between ordinary vision and vision with a single eye, as, for example, the fact that an object seen with one eye looks farther away and smaller.

CHAS. H. JUDD.
WESLEYAN UNIVERSITY.

SCIENTIFIC LITERATURE.

Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbelthiere. Von Dr. med ALBERT OPPEL. Zweiter Theil. Schlund und Darm. Jena, Gustav Fischer. 1897. Price, 20 Marks.

The second part of Professor Oppel's storehouse of facts is a valuable addition to our literature on microscopic anatomy and is to be classed with books of the calibre of Minot's Embryology. It is a handsome volume of 682 pages, 343 text figures and four lithographic plates. In addition to an exhaustive review of all the literature on the œsophagus and intestines (the stomach having been considered in the first volume), it gives a list of the scientific names of the animals, a classification of the vertebrates, a list of all the references, an index of the authors and a complete index of its contents. All in all, it is a hand book of the microscopic anatomy of the œsophagus and intestines.

In general he states that the intestinal canal is always composed of the following layers :

1. A mucosa covered with a layer of epithelium. This, in turn, is divided into the true mucosa and the submucosa, between which there is usually a muscularis mucosæ, and less frequently an additional layer lying upon the muscularis mucosæ, the stratum compactum.

2. A muscularis, usually composed of an inner circular and an outer longitudinal layer.

3. An adventitia, often poorly developed, and towards the body cavity (cœlom) covered with a layer of flat endothelium, the serosa.

After giving the above very general classification of the layers in order to adapt them to all the classes of vertebrates, Oppel states that the following are the important layers :

1. Epithelium.
2. Tunica propria of the mucosa.
3. Stratum compactum.
4. Muscularis mucosæ, circular and longitudinal layers.
5. Submucosa.
6. Circular muscle, } or muscle layers.
7. Longitudinal muscle, }
8. Subserosa.
9. Serosa.

These layers in turn are bound together by glands growing in from the epithelium, bloodvessels, lymphatics and nerves. In general, under the above headings he discusses the whole subject, each time giving the variations corresponding to the order of the families of the vertebrates. Throughout the work most extensive use is made of the literature and nearly all of the figures are borrowed, but they have been carefully redrawn.

After the chapter on the œsophagus the epithelium of the intestine is taken up (pp. 160–232), giving the history of its discovery, and its appearance in animals from amphioxus to man. Then are discussed such subjects as the striated border, cell membrane, intercellular bridges, relation of the epithelial cells to the connective tissues, basement membrane, regeneration and goblet cells. Under intercellular bridges it is interesting to note that sufficient data have been collected to state that the bridges do exist, and it is prophesied that future investigation will fully corroborate this view.

The regeneration of the epithelial cell is discussed under the heading 'Bizzozero's theory.' Bizzozero's observation is that the epithelial cells at the bases of Lieberkühn's crypts are constantly dividing to re-establish the cells of the villi. In order to do this the cells must be shifting constantly from the bases of the crypts towards the tips of the villi. This, according to Oppel, is very unlike regeneration in other organs, and, if true, will lead to the conclusion that the crypts are not glands, but only growing points for the cells covering the villi. It appears to us unfortunate that Oppel does

not see his way clear to accept Bizzozero's theory of the regeneration of the cells covering the villi, as it is the only plausible explanation of it. It does not seem to us that a shifting of the cells from the crypts to the villi necessarily proves that the crypts are not glands, for it is by no means shown that the function of the cells covering the villi is only to absorb. It may also be to secrete. The large number of goblet cells would appear to indicate this. Moreover, similar instances corroborative of Bizzozero's theory are not wanting, as, for instance, in the central nervous system and in the epidermis, and until it is proved to be incorrect it seems to us that it is well to retain the theory.

The mucosa proper is the most complex portion of the intestine, as the folds, villi, and villi upon folds, are only modifications of a simpler membrane. In the mucosa we have all of the characteristics of a lymph gland, extending from the muscularis mucosæ into the folds and villi. Between the bases of the villi and the muscularis mucosæ, the crypts, when present, are lodged. The connective-tissue frame-work of the mucosa has been shown to be composed of fibers, neither white fibrous nor yellow elastic, which are constantly anastomosing to form a reticulum identical with that of lymph nodules. Siegfried has recently shown that they are composed of a body rich in sulphur and phosphorus, which he has called 'reticulin.' Oppel gives a good discussion of this tissue and its importance. Below the crypts the lymphatic tissue is arranged in a layer known as the stratum granulosum.

Between the stratum granulosum and the muscularis mucosæ there is an additional hyaline membrane. This layer had been observed a number of times in the stomach and intestine of various animals and was isolated and discussed by Mall as the stratum fibrosum. Oppel objects to this name, as there had been a difference of opinion regarding its constitution, and substitutes for it the name stratum compactum. Since the appearance of Oppel's book, however, Spalteholz has shown conclusively that this layer is really composed of white fibrous tissue, and, therefore, the name stratum fibrosum is still appropriate. It is to be regretted that Spalteholz's paper appeared too late to be used by Oppel, for the introduction of new terms has a tendency to add confusion to the subject.

The description of Brunner's glands, the lymphatic vessels and nodules, the blood-vessels and nerves is extensive and complete, but it is of such a nature that it cannot be given in a brief review.

The above shows the extent and some of the features of the book. It is a mine of facts arranged in such a manner that anything in it can be easily found. If the work were more critical it would be of much greater value. But as it stands it is a great addition to our literature and will be welcomed by all students of anatomy. FRANKLIN P. MALL.

Whittaker's Mechanical Engineer's Pocket-book. By PHILIP R. BJÖRLING. London, Whittaker & Co.; New York, The Macmillan Co. 1898. 32mo. Pp. 377. Illustrations. Price, $1.75.

This is a 'pocket-book' of the now standard form and page, and including the usual compilation of tables and data for use in the design of machinery and works of engineering. It is neatly put up and well bound, with good paper and clear type of larger size than the microscopic print often seen in such books, vexing the eye and trying the patience of the reader. The first section of the book is devoted to hydraulics and water-wheels, and is exceptionally extensive for a compilation of this size. The section on steam-engines includes modern forms, and gives the proportions of the later constructions. The empirical but standard rules of construction are given, as customarily employed by British designers, and good tables of hyperbolic logarithms and of mean pressures are added. Proportions of details of machine-construction are given very fully, no space being given up to references. The usual and always necessary numerical tables conclude the work.

R. H. T.

The Entropy-Temperature Analysis of Steam-Engine Efficiencies. Prepared by SIDNEY A. REEVE, M.E. New York, Progressive Age Co. 1897. 8vo. Pp. 20, with large folded diagram.

Since the publication of the now famous

paper of Professor J. Willard Gibbs, on 'Graphical Methods in Thermodynamics,' in the Transactions of the Connecticut Academy of Sciences, 1873, the 'entrophy-temperature diagram' has attracted little attention until within a comparatively few years. Brought out by that writer twenty-five years ago, it was left unnoticed for a long time, and it was only when, recently, the eminent and able mathematical physicist and engineer, Mr. J. MacFarlane Grey, employed it in his papers, read before the British Institution of Naval Architects, and later, Professor Cotterill took it up, and the late Mr. Willans gave it practical application in the exposition of the experimental work on his engines which gave him fame, that it has been thought worth while, on the part of engineers, to make use of what proves to be a very beautiful method of exhibiting heat-exchanges and transformations in heat-engine cycles, and especially with the steam-engine.

The recent publication of Professor Ewing on the steam-engine, in which this system is employed to some extent, has called attention to the subject once more, and the indications would seem to be that the entropy-temperature diagram will now find frequent use in the hands of the engineer in the exposition of thermodynamic problems.

The particular form given this diagram, in order to make it available for general use, in this publication by Professor Reeve, is that adopted by Professor Boulvin, of Ghent University, modified by the present author to meet the demands of the profession in a more complete and satisfactory manner. It exhibits the four quadrants, devoted in the present case to entropy-volume changes of steam, to volume-pressure, to temperature-pressure and to entropy-temperature variations, taking the series clockwise, and exhibiting the various curves drawn to a moderately large scale. There are also printed upon the sheet the proper tables and blanks for use in tabulating data of steam-engine trials. Accompanying is a text, descriptive of the diagram and its uses, indicating the character of its lines and the methods of analysis appropriate to the purposes of the engineer.

The text is concise and clear and the plate well made. It would be an improvement were the latter given a light and strong cloth backing, and were a pocket supplied in the cover of its text, in which to preserve it. The cost would be slightly increased, but the sheet would be thus rendered comparatively safe. With care in mounting, and inspection afterward, the diagram could probably be thus guarded without measurable distortion.

The diagram should find many users and prove of real assistance to many investigators and illustrators of thermodyamic problems.

R. H. Thurston.

Cornell University.

SOCIETIES AND ACADEMIES.

ANTHROPOLOGICAL SOCIETY, WASHINGTON.

The 274th regular meeting of the Anthropological Society was held Tuesday, March 1, 1897.

Dr. J. Walter Fewkes read a paper on 'The Altar of the Great Snake of Walpi,' which he described in detail, and stated it to be different from those of the Snake Dance proper.

A number of illustrations, colored charts and drawings were used to show the structure and construction of the altar.

In his paper on 'Snake Worship among the Navaho,' Dr. Matthews stated that the Navahoes have ophiolatrous rites; but they do not handle or introduce live snakes after the manner of the Moki. While their rites do not seem to be derived directly from those of the Moki both have much in common and are probably borrowed from a common source; still they differ in many important respects. The ceremonial circuits are different. A Navaho will not kill a snake; if he finds one coiled in his path he will lift it gently with a stick and throw it to one side. They think the serpent possessed of extraordinary wisdom; that it understands human language and may make evil use of human knowledge; hence their most sacred rites may be performed and their myths may be told only in winter, when the snakes are hibernating. A picture was shown which was a copy of a Navaho dry-painting or sand-altar. It might be considered a Navaho snake-altar. It represented the home of the Navaho snake-god; a minute description of it was given.

Dr. Matthews recounted various reasons why the snake was held sacred by men in all ages and in all parts of the world where it existed. Among the Navahoes he thought the principal reason was that the snake was associated with the lightning. Lightning is regarded as a celestial serpent; hence serpent worship is thought to bring rain. A Navaho myth was related which illustrated the connection between the serpent and lightning. A connection between the feathered rainbow of the Navahoes and the feathered serpent of the Mayas was suggested.

Discussed by Major J. W. Powell, Dr. W J McGee and Mrs. M. C. Stevenson.

J. H. McCORMICK,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 75th meeting, held in Washington on Wednesday, March 9, 1898, the following papers were read:

T. W. Stanton, 'The Mesozoic Section of Sierra Blanca, Texas.'

The strata described are exposed in the mountains and hills within a few miles of Sierra Blanca station, at the junction of the Southern Pacific and Texas Pacific Railroads, ninety miles east of El Paso. The special object of the paper was to describe the occurrence of marine Jurassic strata, whose discovery was recently announced by Professor F. W. Cragin, in the *Journal of Geology*, and to present the paleontological evidence of their age. The beds are limestones, shales and calcareous conglomerates overlying important beds of gypsum which should probably also be referred to the Jurassic. Fossiliferous outcrops one and a-half miles east of Malone station and on the west side of Malone Mountain have yielded about forty species of marine invertebrates of Jurassic types and all distinct from the Lower Cretaceous species of the same region. The fauna is somewhat related to that of the Jurassic at Catorce, San Luis Potosi, Mexico.

F. H. Knowlton, 'The Belly River Horizon on the Upper Missouri.'

The author described briefly the characteristics and extent of the Canadian Belly River beds and the probable preserver of similar beds along the upper Missouri, in the vicinity of Coal Banks, where Messrs. White and Ward discovered a fossil plant locality in 1883. At this point there is a massive light-colored sandstone one hundred feet or more in thickness, associated with coal seams, that is, immediately above beds that contain an invertebrate fauna which seems intermediate between the Colorado and Montana formations. The fossil plant locality is just above this massive sandstone. Farther down the Missouri, near the mouth of Arrow River, the dark Fort Pierre shales, with a characteristic fauna, are seen to clearly overlie this sandstone, and still above that comes the section near the mouth of Judith River, which includes the Fox Hills, or Upper Montana, and the Judith River beds, which are true Laramie.

The flora consists of seven species, two of which are true Laramie species and have not before been found outside of this formation. The remaining forms are regarded as new to science. Of these, three are closely allied to Dakota group species, one to a Laramie species and the other is too poorly preserved to admit of satisfactory comparison.

W. F. MORSELL.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St Louis of February 21, 1898, thirteen persons present, Dr. R. J. Terry exhibited a specimen of a cervical rib from a human subject and discussed the occurrence of structural anomalies of this character. Fifteen persons were elected to active membership.

At the meeting of March 7, 1898, twenty-eight persons present, Professor C. M. Woodward presented a paper embodying an analytical discussion of the efficiency of gearing under friction. The substance of his paper had been given to his class in 1896, and was believed to be new. Few works on applied mechanics, the speaker stated, give any discussion of the matter. Only spur wheels with epicycloidal and involute teeth were considered. The method of investigation was briefly this:

Assuming a coefficient of friction (f) and a constant moment in the driving wheel, the magnitude of the friction overcome, multiplied by the velocity of sliding and again by dt, gave an

expression for the differential of the energy lost in an element of time. The general form for the energy lost is:

$$U = M \sin \psi (a_1 + a_2) \int \frac{r dt}{l}$$

in which ψ is the 'angle of repose,' M is the driving moment, a_1 and a_2 are the angular velocities of the driving and driven wheels respectively, r is the distance from the point of contact to the pitch point, and l is the perpendicular upon the resultant line of action from the axis of the driver. This integration was effected for the 'approach,' then for the 'recess,' and their sum was divided by the whole energy exerted by the driver. This gave the *ratio* of energy lost to energy exerted.

For epicycloidal teeth the exact formula was very complex, but a close approximation was obtained in the following form:

$$\text{Ratio} = r_0 \frac{r_1 + r_2}{r_1 r_2} (0.546 f + 2.72 \frac{r_0}{r_1} f^2).$$

For involute teeth an approximate formula was also obtained in this form:

$$\text{Ratio} = \frac{r_1 + r_2}{2 r_2} (f \cot \theta - \frac{2}{3} f^2 \cot^2 \theta)$$

in which θ is the constant angle between the normal to the teeth and the line of centers. These ratios subtracted from unity give the efficiency.

For the sake of comparison, a table was produced giving the efficiency for different values of the coefficient of friction f, and for equal wheels and for the same number of teeth, 12, on each wheel.

Efficiency of Spur Wheels. Equal wheels with 12 teeth each.

Kind.	$f=0.03$	$f=0.10$	$f=0.15$	$f=0.20$	$f=0.25$
Epicycloidal.	0.9915	0.9693	0.9514	0.9318	0.9103
Involute.	0.9923	0.9746	0.9622	0.9501	0.9381

Dr. Amand Ravold demonstrated the method, recently introduced by His, of differentiating the typhoid bacillus from Bacillus coli-communis, by the use of semi-solid acidulated media, in which, at blood temperature, the round colonies of the typhoid bacillus assume a peculiar fimbriated form of growth, because of the motility of the bacteria in the slightly yielding medium, which, in most cases, readily distinguishes them from the more whetstone-shaped colonies of the colon bacillus, which does not produce the peculiar fimbriation in plate cultures. In tube cultures in the same general medium, but prepared with a slighter acidity and somewhat less solidity, a uniform clouding of the entire tube, due to the swarming of the bacteria, was shown to be characteristic of the typhoid bacillus, while the colon bacillus was definitely confined to the immediate vicinity of the thrust. The media in both cases are made up without peptone. The formulæ are:

For Plate Cultures.		For Tube Cultures.	
Agar	10 grams.	Agar	5 grams.
Gelatine	25 "	Gelatine.	80 "
Beef extract	5 "	Beef extract	5 "
Glucose	10 "	Glucose	10 "
Salt	5 "	Salt	5 "
Normal acid	20 cc.	Normal acid	15 cc.
The whole increased to 1000 cc.		The whole increased to 1000 cc.	

The growth of the two species in question, on potato and in milk cultures with litmus, was also demonstrated.

Eight persons were elected to active membership.

WILLIAM TRELEASE,
Recording Secretary.

TORREY BOTANICAL CLUB, FEBRUARY 23, 1898.

THIS meeting was held in the large lecture hall of the College of Pharmacy, and about 150 persons were present. Vice-President Rusby presided. The minutes were read and approved. Arrangements were announced for summer courses in botany, provided by the committee of instruction of the Club. Course 1, is to commence March 4th, at the College of Pharmacy under Mr. W. A. Bastedo, with weekly lectures and excursions on Saturdays. Pursuant to motion of Dr. Britton, the chairman made this evening the announcement of the Field Committee for the year 1898, to consist of three members, with power to add to their number. The Committee was announced to consist of Mr. W. M. Clute, chairman; Professor F. E. Lloyd and Mr. W. A. Bastedo. The evening was devoted to an illustrated lecture by Mr. Cornelius Van Brunt on the wild flowers of the Canadian Rockies, with lantern slides exquisitely colored from nature by Mrs. Van Brunt. Numerous

views of the scenery of their surroundings were shown, especially of the Selkirk Mountains and about Banff. Here, instead of *Rudbeckia* and *Leucanthemum*, *Gaillardia aristata* covers the fields with multitudes of purple and yellow flowers. Vetches are numerous, blue clover (lucerne) takes the place of red; turf for the lawns is composed of Buffalo clover only (*Trifolium reflexum*). Beautiful examples of *Hedysarum*, *Lathyrus* and *Oxytropis* occur among the Leguminosæ; *Linnæa borealis*, *Potentilla fruticosa* and several species of *Allium* were abundant, also *Parnassia palustris* and *P. fimbriata*. Near the hotel at Banff great numbers of Shepherdia bushes are hung with their red berries. The red berry-like fruit of the Strawberry-Blite, *Chenopodium capitatum*, was seen in great abundance in parts of the Canadian National Park, as was *Galium boreale*, *Anaphalis margaritacea* and several species of *Gentiana* and of *Pedicularis*. The Asters were represented by *A. Fremonti*; instead of the dandelion, *Troximon* with similar blossom had become the most common flower; myriads of hare-bells, apparently *Campanula rotundifolia*, dotted the roadsides, and the horse if left to himself would hunt them out as the choicest eating. One field was a beautiful mass of squirrel-grass, *Hordeum jubatum*; larkspurs grew all along the road; blue flax (*Linum Perenne*) and *Rosa acicularis Bourgeana* were still in blossom. About the numerous hot springs and ponds formed from them grew plants of warmer latitudes, here blooming early, as *Gentiana detonsa* in July. *Lobelia Kalmii* was blooming in the hot water. Many parts of this park have lost their beauty from the continuous forest fires. The Canadian Pacific Railroad employs watchmen whose sole duty is to guard against these fires. Digging shows that such fires have ravaged this region since times before history. The blackened ground is slowly covered by fireweed (*Epilobium angustifolium*) and, after the charred trees have fallen, by vigorous young growth of balsam-spruce and pine. The abundant painted cup disputes with the fireweed the position of most showy flower of the region. An interesting visit to Lake Louise and neighboring glaciers was described, also to Mirror L., with altitude of 5,480 feet. Great numbers of crossbills were met near the glacier, feeding upon pine cones; three columbines, *Aquilegia*, were close to the snows, with *Ledum latifolium*, *Pentstemon Menziesii*, *Valeriana Sitkensis* and *Arnica cordifolia*. *Habernia hyperborea* was everywhere through the woods. The moss-campion, *Silene acaulis*, covered dry rocks with long tap-roots going down three feet or more to water. Strangely enough, the night-flowering catchfly, *Silene noctiflora*, was here in force. *Bryanthus* and *Cassiopea* were in fine flower. Lyall's Larch grew higher up the mountain than any evergreen, and its bright green was already turning now in August to its autumn yellow.

EDWARD S. BURGESS,
Secretary.

THE NEW YORK ACADEMY OF SCIENCES—SECTION OF BIOLOGY, FEBRUARY 14, 1898.

THE first paper was on 'The Eparterial Bronchial System of the Mammalia,' by Professor Geo. S. Huntington, a full abstract of which will appear in an early number of SCIENCE.

Professor F. S. Lee followed with a report of his researches on 'The Function of the Ear and the Lateral Line in Fishes.' Previous work by the author has shown in detail that the ear of fishes is a sense-organ of equilibrium, the semicircular canals mediating the perception of rotary movements, the otolithic portions that of the position of the body in space. The paper reported the results of experiments proving that the otolithic organs mediate also the perception of progressive movements. Thus the hypotheses of Mach and Breuer in this regard are experimentally confirmed. All attempts of the author, as well as those of Kreidl and others, have failed to demonstrate in fishes the existence of any power of hearing in the customary sense of the word. It must be concluded that this sense is wanting and that the ear in fishes is purely equilibrative in function.

Cutting of all the nerves supplying the organs of the lateral line, or destruction of the organs, does not appear to have any effect on the fish; but this should be re-examined. Destruction of the organs, however, combined with the removal of the large pectoral and ventral fins in *Batrachus tau* causes evident lack of apprecia-

tion of equilibrium both during swimming and at rest. More important is the fact that central stimulation of the lateral nerve causes coordinated compensating movements of the fins, exactly similar to those caused by similar stimulation of the acoustic nerve. In both cases a reflex arc between sense-organs and locomotor organs exists. The inference is that the organs of the lateral line are sense-organs of equilibrium analogous to the ear. These results testify indirectly to the correctness of the theory that the ear is a derivative of the lateral line. The equilibrium function is crude in the latter, more perfected and differentiated in the former. The sense of hearing in vertebrates arose along with the change from a water to a land existence, and the appearance of a *papilla acustica basilaris*. In vertebrates above the fishes, the ear appreciates all kinds of visible motion that the physicist recognizes, rotary, progressive or translatory and vibratory.

GARY N. CALKINS,
Secretary of Section.

SCIENTIFIC JOURNALS.

The American Naturalist for February opens with an article by E. C. Case, reviewing the significance of certain changes in the temporal region of the primitive reptilia. This is followed by a paper by the late James Ellis Humphrey on Manasseh Cutler, one of the pioneers of American science, born in 1741. Professor J. H. Comstock and Mr. J. G. Needham continue their study of the wings of insects, taking up the venation. Other articles follow by Dr. F. C. Kenyon on the daily and seasonal activity of a hive of bees, by Dr. Erwin F. Smith on the first annual meeting of the Society for Plant Morphology and Physiology, and by Dr. Charles E. Bessey on some characteristics of the Foothill vegetation of western Nebraska.

THE contents of the April *Monist* are predominantly philosophical. The number opens with an article by Professor John Dewey on 'Evolution and Ethics,' which seeks to correct the view of the late Professor Huxley that Nature is essentially unmoral. Dr. Woods Hutchinson, of the University of Buffalo, writes on *Lebenslust*, a scientific homily upon the nobility and righteous pleasure of being alive; E. E. Constance Jones discusses 'An Aspect of Attention;' Professor C. Lombroso seeks to substantiate his theory of the degeneracy of genius by considering certain 'Regressive Phenomena in Evolution,' while Professor Ferdinand Hüppe, of Prague, discusses in a long contribution, and in the light of a special philosophical theory, the 'Causes of Infectious Diseases,' attacking the prevailing views of Virchow, Pasteur and Koch. Finally, in a disquisition entitled 'The Unmateriality of Soul and God,' Dr. Paul Carus attempts to banish the metaphysical materialistic notion of substance from the domains of psychology and theology.

The Atlantic Monthly for April contains an article by Professor George H. Darwin which analyzes the relations of the earth to the moon and the solar system, the tidal phenomena produced by the moon which react upon it in turn, and details the prospective future history of the two bodies down to the times when they will revolve in unison, and our days and months will be of the same duration. Mr. John Muir continues his articles upon Government Parks with a description of the Yellowstone. Dr. McGee contributes a vivid description, in part based on personal experience of the five stages of thirst in the desert.

NEW BOOKS.

Évolution individuelle et hérédité. FELIX LE DANTEC. Paris, Alcan. 1898. Pp. 308.

Practical Electricity and Magnetism. JOHN HENDERSON. London, New York and Bombay, Longmans, Green & Co. 1898. Pp. xv+388.

Birds of Village and Field. FLORENCE A. MERRIAM. Boston and New York, Houghton, Mifflin & Co. 1898. Pp. vi+406. $2.00.

A Laboratory Manual in Practical Botany. CHARLES H. CLARK. New York, The American Book Company. Pp. 271. 96 cents.

The Story of Life in the Seas. SIDNEY T. HICKSON. New York, D. Appleton & Co. 1898. Pp. 173. 40 cents.

SCIENCE

FRIDAY, APRIL 1, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*MIMICRY IN INSECTS.**

SHARING in the perplexity avowedly felt by many of my predecessors in this chair as to the choice of a subject for the annual address—perplexity arising rather from the redundancy than from the scarcity of entomological matter—I have been led to think, considering the wide-reaching importance of the questions involved and the unmistakable interest shown in the recent discussion at two of our meetings, that some account of the mimetic relations existing among insects might not be out of place. Having for a considerable period devoted some attention to the matter, I propose to pass in review what has been placed on record; and if, in so doing, I traverse ground very familiar to most of us, my excuse must be the fascinating interest which attaches to the whole subject.

The application, by Henry Walter Bates, our lamented President, of the great principle of natural selection in elucidation of the mimicries found among insects† is too well known to require any detailed repetition here. It is sufficient to recall that, as the result of many years' experience in tropical South America, Bates established the facts that (1) among the abundant and conspicuous butterflies of the groups Da-

* Address of the President, Mr. Roland Trimen, F.R.S., before the Entomological Society of London, 1898.

† Trans. Linn. Soc., XXIII. (1862).

nainæ, Heliconiinæ, Acræinæ, and some Papilioninæ were found very much rarer mimicking forms, chiefly of the group Pierinæ, but partly belonging to other groups, and some even to the Heterocera, which, departing very widely from the aspect of their respective allies, imitated with more or less exactness the abundant species in question; (2) the numerous and showy Danainæ, etc., although of slow flight, did not appear to be molested by the usual insectivorous foes; and (3) the members of these unassailed tribes possessed malodorous juices not found in the mimicking forms or their allies. From these data he argued that the examination of these extraordinary resemblances was to be found in the great advantage it would be to species undefended by offensive secretions, and therefore palatable and much hunted down, to find escape in the disguise of species recognized and avoided as unpalatable; and traced the mimicries to the long-continued action of natural selection, perpetually weeding out by insectivorous agencies every occurring variation not in the direction of likeness to the protected forms, but as perpetually preserving, and so aiding the development by heredity, of every variation favorable to the attainment of the protective mimicry.

This sagacious application of the Darwinian theory in solution of one of the most difficult and baffling of the problems presented to zoologists was of the greatest service and encouragement to all students of evolution. I retain to-day the liveliest recollection of the delight I experienced in the perusal of a copy of Bates's Memoir received from himself; for his work was not that of the mere cabinet systematist, but came with all the force of face-to-face commune with the abounding life of the tropics.

Before two years had passed, Bates's explanation of mimicry was confirmed by his former companion in exploration, Alfred Russel Wallace, who, working with equal devotion in the Malayan Islands, had observed and was able to adduce a strictly analogous series of mimetic resemblances among Oriental butterflies, and gave his unreserved acceptance of the Batesian interpretation.* Such support from the cofounder with Darwin of the theory of natural selection, and from a naturalist of the widest experience in both Western and Eastern tropics, was of the greatest weight with evolutionists generally.

My own contribution to the subject was read to the Linnæan Society in March, 1868.† In the previous year I had made an entomological tour in Natal, and had enjoyed some precious opportunities of observing in nature several cases of mimicry between species not inhabiting the Cape Colony. There was no claim to originality in my paper; it simply rounded off the case by adding from Africa, the third great tropical region of the globe, a series of instances and observed facts confirmatory of those brought forward by Bates from the Neotropical, and by Wallace from the Oriental region. Of course, I had nothing like the extended field experiences of those great naturalists, and the African material then available was but scanty; but it so happened that perhaps the most striking and elaborate of all recorded cases of mimicry—that exhibited by the females of the *Merope* group of *Papilio*—had come under my personal observation in South Africa, and I was thus in a position to describe satisfactorily a wonderful illustration of the Batesian theory.‡

* Trans. Linn. Soc., XXV. (1864).

† Tran. Linn. Soc., XXVI. (1869).

‡ At various subsequent dates I was enabled, through the valuable aid of Mr. J. P. Mansel Weale and Colonel J. H. Bowker, to make known to science conclusive evidence of the species-identity of the three mimetic females of *Papilio cenea*, and of the pairing of the widely-differing sexes of that species. See Trans. Ent. Soc. Lond., 1874, p. 137, and 1881, p. 169; and 'South African Butterflies,' III., p. 254 (1889).

It will be remembered that Bates, in his memorable paper (*l. c.* p. 507), also brought to notice the very close resemblances, or apparent mimicries, which unquestionably exist between species belonging to different groups or subfamilies of protected distasteful butterflies themselves; but neither he nor Wallace felt able to give any explanation of these instances, which obviously differed very materially from the cases of mimicry of an unpalatable protected species by a palatable unprotected one. Not until 1879 was there any elucidation of this side of the matter, but in May of that year appeared in 'Kosmos,' Fritz Müller's notable paper on '*Ituna* and *Thyridia*,' which was translated by Professor Meldola, and printed in our 'Proceedings' for the same year (p. xx.). In this memoir Müller made the valuable suggestion that the advantage derivable from these resemblances between protected forms was the division between two species of the percentage of victims to the inexperience of young insectivorous enemies which every separate species, however well protected by distastefulness, must pay.

Professor Meldola not only brought forward and supported, with all his wonted grasp and acumen, F. Müller's daring interpretation of this phenomenon, but in 1882,* in a paper discussing the objections brought against Müller's view, made a distinct advance by showing how that view could justly be extended to explain the characteristic and peculiar prevalence of one type of coloring and marking throughout numbers of species in protected groups—so especially noticeable in the subfamilies Danainæ, Heliconiinæ and Acræinæ.

In 1887 was published† Professor Poulton's most interesting memoir entitled 'The Experimental Proof of the Protective Value of Colors and Markings in Insects in reference to their Vertebrate Enemies,' which dealt in great detail with the actual results of numerous experiments conducted by himself and other naturalists with the object of ascertaining to what extent highly conspicuous (almost always distasteful) larvæ and perfect insects are rejected or eaten by birds, lizards and frogs. The conclusions given at the close of this paper (pp. 266–267) cover a wide range in connection with the subject of warning coloration, and among them I would call special attention to No. 5, in which the author points out that "In the various species in which a conspicuous appearance is produced by color and marking, the same colors and patterns appear again and again repeated," and adds that "In this way the vertebrate enemies are only compelled to learn a few types of appearance, and the types themselves are of a kind which such enemies most easily learn." This generalization certainly had the merit of first detecting a great additional advantage derivable from the common aspect exhibited by a number of protected forms in the extended 'Müllerian' associations indicated by Professor Meldola; and it was applied by Wallace to the case of the Heliconiidæ in the comprehensive survey of warning coloration and mimicry generally given in 'Darwinism' (Ch. IX., pp. 232–267, 1889). We are further indebted to Professor Poulton for the discussion and summary of all extant data up to 1890 in his 'Colors of Animals,' a work which abounds in pregnant suggestion and indicates with justice and clearness how far the evidence forthcoming was valid and in what directions evidence still lacking should be sought.

Wallace well observed ('Darwinism,' p. 264) that "to set forth adequately the varied and surprising facts of mimicry would need a large and copiously illustrated volume; and no more interesting subject could be taken up by a naturalist who has

* Ann. and Mag. Nat. Hist. (5), X., pp. 417–425.
† Proc. Zool. Soc. Lond., 1887, pp. 191–274.

access to our great collections and can devote the necessary time to search out the many examples of mimicry that lie hidden in our museums." A work ostensibly of this character was issued in 1892–93, in two parts, from the pen of the late Dr. Erich Haase, under the title of 'Untersuchungen über die Mimicry auf Grundlage eines natürlichen Systems der Papilioniden;'* and last year an English translation of the second part was published and has quite recently been reviewed by Professor Poulton.† This treatise is of large quarto size, and the first part contains 120 pages and 6 colored plates, while the second extends to 158 pages and includes 8 colored plates. The first part ‡ deals solely with the family Papilionidæ (*s. str.* = subfamily Papilioninæ) and principally with the great genus *Papilio* (*s. lat.*), which, on grounds of structure, system of markings, form of larvæ and pupæ and food-plants of larvæ, is divided into the three subgenera of *Pharmacophagus*, *Cosmodesmus* and *Papilio* (*s. str.*). With the utmost minuteness the species assigned to these groups, with their sexual, geographical or mimetic variations, are traced through the four zoological regions recognized by the author, and very elaborate analysis of markings is made in aid of arriving at their natural affinities from a phylogenetic point of view. Haase shows that in *Papilio* the models which are mimicked by other species of that great genus are always members of the *Pharmacophagus* group, or, as he calls them, 'Aristolochia-Butterflies'—whose larvæ feed on that tribe of plants, and which, as he contends, derive their offensive juices directly from the poisonous properties of their food in the early state.

In Part 2 § a lengthy account is given of the cases of mimicry occurring throughout the class of insects, and reference is also made to the few known instances in other classes of animals. The Lepidoptera occupy the bulk of the memoir, and, as in Part 1, a geographical order is followed, the mimicries in each of the four zoological regions being given under each of their respective families and genera, but in separated accounts of (firstly) models and (secondly) mimickers. In the 'Allgemeiner Theil,' which concludes the work and occupies about half of Part 2, there are sections treating of mimicry (*a*) within the limits of the old genus *Papilio* (in connection with Part 1), (*b*) between 'immune and non-immune' Lepidoptera, and (*c*) among 'immune' Lepidoptera themselves; followed by a consideration of objections to the theory of mimicry, and of mimicry as a part of protective adaptation to the environment.

While I regard Part 1 as a memoir of value, and as likely to prove serviceable to the student of a group so difficult to classify as the Papilioninæ, and while I recognize the great labor and research displayed throughout the work in the assembling of the accessible facts and data, I must reluctantly record my concurrence in Professor Poulton's severe criticism of the extremely unsatisfactory nature of the general treatment of the subject in Part 2. Apart from the cumbrous handling of the mass of details accumulated, the writer manifests such disregard of obvious difficulties, such unscientific haste in jumping at conclusions, and such inadequate recognition of what had been accomplished by previous investigators, that one can only regret that he ever entered on the speculative part of his work, and did not confine his energies to the better concentration and arrangement of the materials so assiduously collected.

Among recent contributions to the subject we shall, I think, all agree in assigning

* In Vol. III. of *Bibliotheca Zoologica* (Stuttgart).
† *Nature*, 4th and 11th November, 1897.
‡ *Entwurf eines natürlichen Systems der Papilioniden.*
§ Subtitle, 'Untersuchungen über die Mimicry.'

a high place to the memoirs with which Dr. F. A. Dixey has enriched our 'Transactions.' In 1894 he read before the Society his elaborate paper 'On the Phylogeny of the Pierinæ as illustrated by their Wing-markings and Geographical Distribution,' and took occasion to discuss the wide divergence from the primitive or typical pattern of the group caused by mimicry in such genera as *Euterpe*, *Pereute*, *Dismorphia*, etc. Adopting the Müllerian interpretation as expanded by Meldola, he proceeded to offer the original suggestion that, in the acquisition of closer resemblance between two or more protected forms, it was not necessary that in every instance the process of adaptation should lie solely in the imitation of one particular form as model, but that there might very well exist *mutual* convergence of the forms concerned, thus accelerating the attainment of the common beneficial resemblance. This 'reciprocal mimicry' the author further explained in a paper read in 1896 'On the Relation of Mimetic Patterns to the Original Form' (pp. 72–75), by a consideration of certain mimetic sets of Heliconii, Pierinæ and Papilioninæ, which present features and relations of pattern and coloring explicable apparently in no other way than by the hypothesis in question. This paper also gave a lucid demonstration, traced through corresponding series of existing forms of both mimetic and non-mimetic Pierinæ, of "the successive steps through which a complicated and practically perfect mimetic pattern could be evolved in simple and easy stages from a form presenting merely the ordinary aspect of its own genus," and further adduced reasons for holding that "it is not necessary that the forms between which mimicry originates should possess considerable initial resemblance." In his latest memoir, 'Mimetic Attraction,' read on May 5th last,* Dr. Dixey expanded a suggestion that he had previously (1896) made respecting divergent members of an inedible group, to point out—still from evidence in the Pierine subfamily to which he has devoted so much fruitful study—"how the process of gradual assimilation starting from one given point may take not one direction only, but several divergent paths at the same time," with the result that a more or less intimate mimetic relation was brought about with several protected forms of quite different affinities, though each connected in their coloring and aspect with some group of distasteful associates. He further set forth very fully the distinction which exists between the mimicry of inedible by edible forms, which could only be in one direction and was of advantage to the mimicker alone, and the assimilation among inedible forms themselves, where the mimetic attraction acts reciprocally, to the advantage of all participators.

*Trans. Ent. Soc., Lond., 1897, p. 317.

Another of our Fellows, Colonel C. Swinhoe, distinguished for his wide and intimate knowledge of Oriental Lepidoptera, read before the Linnæan Society, in 1895, a most interesting paper 'On Mimicry in Butterflies of the genus *Hypolimnas*.'* In this memoir, as the author points out, a small group of wide-ranging mimetic insects is followed throughout its geographical distribution; and the process of mimetic modification is traced through the female, from the amazing instability of that sex of *H. bolina* (local form) in the Fiji Islands, where the male is stable and of the normal ancestral pattern and coloring, to the opposite extreme in Africa, where (with the exception of *H. misippus*) both sexes of the known allied forms of the genus are equally mimetic.† The singular contrast between

* Linn. Soc. Journ. Zool., XXV., pp. 339–348.

† It should be noted that in the African *H. salmacis* and the Malagasy *H. dexithea* the sexes are alike and non-mimetic, and that therefore these species probably most closely approximate to the primitive appearance of the genus.

the numerous modifications of the female of the *Bolina* type, and the absolutely constant imitation of *Danais chrysippus* alone by the ♀ *H. misippus* is well brought out, and the different courses thus pursued by the respective females are shown to depend on the range, variation and abundance of the model that is mimicked. Colonel Swinhoe had previously (1887) published a good account of mimicry in Indian butterflies,* and in it made special reference to the remarkable series of close likenesses between species belonging to different subgenera of the great protected genus *Euplœa*.

So much prominence has naturally been given to the very conspicuous development of mimicry among the Lepidoptera that it is not uncommon to hear the matter spoken of as if limited to butterflies and moths, and even entomologists need to be reminded of the prevalence of the phenomenon among other orders of insects. The stinging Hymenoptera furnish the most numerous models to members of other orders, being closely mimicked by numerous Diptera, by many heterocerous Lepidoptera, by various Carabid, Heteromerous and Longicorn Coleoptera, and by some Hemiptera; while certain ants are well imitated by spiders. As regards Coleoptera mimicry is mainly found within the limits of the order itself—*e. g.*, Cicindelids by Heteromera and Longicorns, Carabids by Heteromera, Malacoderms by Longicorns, and Rhynchophora by Longicorns; but certain Cicindelid and Rhynchophorous beetles are closely copied by Orthoptera, belonging respectively to the genera *Condylodeira* and *Scepastus*. Lepidoptera do not seem to find mimickers beyond their own order, unless the case quoted by Haase† from E. Hartert, of the resemblance of a large Cicada to the Indian *Thaumantis aliris* (Morphinæ) be one of actual mimicry. Nor do Diptera appear to be models for imitation, except in the case of the hunting spiders, which mimick the Muscidæ they chase; although the neuropterous *Bittacus* certainly bears a strong likeness to Tipula, and may possibly find the advantage of that harmless aspect in approaching its prey. It cannot be denied that some of the interordinal mimicries are even more impressive and striking than those so notable among butterflies, the excellence of the superficial disguise of general outline, proportion of parts, coloring and markings being so great as to throw into obscurity the really vast structural discrepancies. Such cases as the imitation of the South American wasps of the genera *Polybia* and *Synœca* by moths of the genera *Sphecosoma* and *Myrmecopsis*,* of the Bornean sand-wasp *Mygnimia aviculus*, by the beetle *Coloborrhombus fasciatipennis*,† or of the Philippine tiger-beetle *Tricondyla* by the cricket *Condylodeira*, ‡ are absolute marvels of deception, all belonging to that special phase of mimicry where the obvious advantage to the unarmed mimic lies in being mistaken for the armed and formidable model.

As the Lepidoptera are at present the only order in which a very considerable number of mimetic relations have been observed, it may be of service to note here the various directions in which mimicry ramifies within the ordinal limits. The very large majority consists of cases where (*a*) Rhopalocera are copied by other Rhopalocera; and, taking the groups in succession, we find that (1) Danainæ (including Neotro-

* Journ. Bombay Nat. Hist. Soc., II., pp. 169–174.

† *Op. cit.*, II., p. 10. Haase (on p. 11) cites Brauer to the effect that the genus *Drepana* is mimicked by the neuropterous *Drepanopteryx*, which is stated to eed on Lepidoptera.

* See Haase, *l. c.*, II., p. 76, Pl. XIII.

† See Pryer, Trans. Ent. Soc., 1885, p. 369, Pl. X., who in the same place also figures another most striking case from Borneo, in which the hymenopterous *Triscolia patricialis* is mimicked by the lepidopterous *Scoliomima insignis*.

‡ See Bates, *l. c.*, p. 509.

pinæ) are mimicked by members of their own subfamily, by Satyrinæ, Heliconiinæ, Nymphalinæ, Erycinidæ, Pierinæ and Papilioninæ; (2) a few Morphinæ by Papilioninæ; (3) Heliconiinæ by Pierinæ; (4) Acræinæ by Nymphalinæ, Lycænidæ, Pierinæ, and Papilioninæ; (5) some Nymphalinæ, by members of their own subfamily; (6) Pierinæ by species of their own subfamily, and very rarely by Satyrinæ;* and (7) Papilioninæ by members of their own subfamily and by certain Pierinæ.

The next series is composed of those comparatively few instances where (*b*) Rhopalocera are imitated by Heterocera; and here it is found that (1) Danainæ (true, and Neotropinæ) are mimicked by Castniidæ, Chalcosiidæ (three different genera); Arctiidæ (two different genera), Dioptidæ (three different genera), and Geometræ (two different genera); (2) a few Acræinæ by Melameridæ (two different genera); (3) Papilioninæ by Castniidæ, Chalcosiidæ, and Arctiidæ. † Much rarer are the known cases of (*c*) mimicry of Heterocera by Rhopalocera; but (1) certain Uraniidæ are simulated by Papilioninæ; (2) Agaristidæ by Nymphalinæ; and (3) Lithosiidæ by Nymphalinæ. The mimicry of (*d*) Heterocera by Heterocera seems also to have been but seldom observed, but the cases recorded consist of (1) Agaristidæ by Liparidæ; (2) Melameridæ by Chalcosiidæ; (3) Geometridæ by Uraniidæ and Chalcosiidæ, and (4) Lithosiidæ by Agaristidæ.*

It will be seen that the foregoing enumeration includes not only the Batesian mimicries, but also those coming under the category of Müllerian associations of distasteful forms. To the latter class belong all cases occurring within the limits of the subfamilies Danainæ, Heliconiinæ and Acræinæ, and also many of those existing between species of one or more of those groups and certain Pierinæ and Papilioninæ, as well as (among moths) the Agaristidæ, some Lithosiidæ, and very probably others. It seems clear that, in the same circle of various species all approximating with more or less accuracy to one special type of coloration, marking and outline, there will often be found, in the larger and more comprehensive of such associations, both Batesian and Müllerian mimicries; this is, indeed, distinctly to be gathered from some of the cases tabulated by Bates himself, and has been lately well illustrated in the exceptionally rich Neotropical series of 'homœochromatic' forms brought before us by Mr. W. F. H. Blandford, among which were several of the actual specimens figured by Bates in illustrating his famous memoir. In the scarcely less opulent

* In the Oriental region *Delias* is mimicked by *Prioneris* and *Pieris*, and in the Ethiopian region *Mylothris* by *Pieris* and *Eronia*. An interesting case in support of the probable distastefulness of *Mylothris* is found in Madagascar, where the abundant *M. phileris* is mimicked by the very scarce *Elymnias masoura*, a Satyrine which is extremely divergent in coloring from all known members of its genus and subfamily.

† Col. Swinhoe informs me that the Pierine *Teracolus limbatus*— 'the southern form of *T. etrida*'—is accurately mimicked by the Geometrid moth, *Abraxas etridoides*. This case seems to support Col. Swinhoe's opinion (Proc. Ent. Soc. Lond., 1897, p. xxxvii.) that the species of *Teracolus* are inedible. I have noted (Proc. Zool. Soc. Lond., 1894, p. 21) another instance of marked resemblance to the females of the smaller East African *Teracoli* in the Satyrine, *Physcæneura pione*.

* There is some ground for suspecting *Acherontia atropos* to be a protected species. It has an apparent mimicker in Africa—its natural habitat—in the shape of another Sphingid of almost equal size, *Protoparce solani*, which, when seen at rest on tree trunks, I have, on more than one occasion, mistaken for the Death's Head. I do not know if any experiments as to the distastefulness of *Acherontia* have been made; but I incline to the belief that, if this moth is shunned by any insectivorous animals, such avoidance is more likely to be due to its squeaking powers and its threatening gesture, when irritated or alarmed, of suddenly elevating the robust and spiny fore legs. I know of no other moth that assumes this menacing attitude.

Oriental region (as Col. Swinhoe has pointed out in the paper above mentioned, and has more fully of late described to me) the same state of things is prevalent, extensive Müllerian inedible associations among (*e. g.*) the species of the three main groups into which the old genus *Euplœa* has been divided, being 'attended and surrounded' by numerous true mimics belonging to edible groups. The far poorer Ethiopian region has, to my knowledge, yielded as yet only a few series including both inedible and edible imitators; but in the group of which the Danaine *Amauris egialea* is the center there appears the exactly similar *Danais* (*Melinda*) *morgeni;* and in the same way the much-mimicked *Amauris echeria*, var., has in East Africa a protected companion in the female *Acræa johnstoni*, while there is some reason for thinking that the widely-distributed *Acræa encedon* is modified in resemblance to the dominant *Danais chrysippus.* Perhaps the most remarkable of these associations is that which surrounds the abundant and extremely conspicuous slow-flying diurnal Lithosiid moth, *Aletis helcita.* The apparently protected analogues of this insect are the closely similar Lithosiid *Phæagarista helcitoides* and Agaristid *Eusemia falkensteinii,* while the Batesian mimickers are found in the Nymphaline butterflies, *Euphædra ruspina* and *E. eleus,* and the aberrant Lycænid, *Liptena sanguinea.* Another point of interest in this last-named series is its great similarity in coloring and marking to that which is headed by *Danais chrysippus*, the differences being merely that in the *Aletis* set the red ground-color is brighter and the white spots in the black margins are larger; so that from the aspect of warning of distastefulness to enemies the two sets may be regarded as practically but one.

Among the Batesian mimicries in the Ethiopian region, I wish to revert more fully to the very striking and instructive case, already briefly referred to, presented by the females of the *Merope* group of the genus *Papilio*, because it has largely gained in interest by the increase of our knowledge in recent years. In 1867, when I wrote the paper above mentioned,* only three forms of the *Merope* group were known, *vid.:* the West African *P. merope*, the South African *P. cenea* (then regarded as not more than a variety of *P. merope*), and the Madagascar *P. meriones.* Of these the last-named alone had the sexes nearly alike, *vid.:* of a very pale yellow, margined with black in the forewings, and with the hind wings more or less black-marked and bearing conspicuous tails; each of the two continental species presenting not only the utmost disparity between the sexes, but also the singular phenomenon of a polymorphic female, invariably without tails, accurately mimicking two or three widely-differing species of Danainæ, and at the same time offering numerous linking variations. I was justified in considering that the Madagascar form should be regarded as retaining the ancestral condition of this group of *Papilio,* while the females of the continental forms had been profoundly modified in the mimetic directions specified; and I pointed to the costal black bar in the fore wings of the female *P. meriones* as possibly indicating the feature on which natural selection had been able to work, to the ultimate production of close imitation first of the lighter and at length of the darker Danainæ concerned.

It was startling to learn, in 1883, that a newly-discovered continental form of the group, *P. antinorii*, inhabiting Abyssinia, like the Madagascar *P. meriones,* had the sexes quite alike, except for the costal black bar in the female; while in 1889 there was described from the Comoro Islands a fifth and very distinct species, *P. humbloti,*

* Trans. Linn. Soc., XXVI.

in which the sexes resemble each other even more closely than in the Madagascar form, and which, therefore, in all probability exhibits a still more primitive condition.

The survival of the ancestral similarity of the sexes on the African mainland, so far from the Malagasy archipelago as Abyssinia, was a discovery of much importance; and the greatest interest was added to the whole case when, in 1890, Professor N. M. Kheil,* of Prague, described and figured two most remarkable new forms of the female *P. antinorii.* These females, given by the author as 'ab. *niavioides*' and 'ab. *ruspinæ*,' respectively, in coloring and pattern mimic *Amauris dominicanus* and *Danais chrysippus*, almost as closely as do the *hippocoonoides* and *trophonius* females of *P. cenea*, but yet retain on the hind wings the fully-developed tails possessed by the male and the unmodified female.† One would naturally suppose that these conspicuous appendages to the hind wings, never found in the Danaidæ, but so characteristic of many groups of *Papilio*, would have been among the first features to be lost in the process of assimilation to the Danaine models; and, as Professor Kheil mentioned in his paper, that the tails of the specimens of '*niavioides*' were injured, but had been restored in the figure, I felt a little doubtful about them, and ventured recently to address him on the subject. He most obligingly answered my inquiries, stating that the two forms of female were still in his possession, and that while the tails of the ab. *niavioides* were injured, as originally pointed out, those of the ab. *ruspinæ* were intact and are correctly delineated in Haase's figure, which—as well as that of *niavioides*—was drawn from the actual specimens, lent by Professor Kheil. It is to be noted that the tails are uniformly black, in accord with the broad hind margins, instead of being pale yellow with a short median streak of black, as in the female of the male coloration. Professor Kheil further informed me that the discoverer of these forms, the late Dr. A. Stecker, who collected at Lake Tana, brought together seven males, two females like the male, and one only of each mimetic form of female, and that he reported the male as very common, while the females seldom occurred.

This persistence in Abyssinia of the original female *P. antinorii*, side by side with two mimetic forms of the same sex retaining her outline of hind wings, but far divergent from her in advanced imitation of two very different Danainæ belonging to distinct genera, is strong confirmatory evidence of the view I advanced as to the development of the various tail-less mimetic African females of the group from the ordinary male-like type of female solely prevalent still in the Malagasy sub-region. From analogy with what occurs over so large an area of the rest of Africa, I confidently anticipate that we shall receive from Abyssinia intermediate gradations between the three known forms of the female *P. antinorii*; and as the dominant model, *Amauris echeria*, is represented in Abyssinia by the abundant and very closely allied *A. steckeri*, I should not be surprised to see another mimetic female of *P. antinorii* closely resembling the typical *P. cenea*. More than this, we may not unreasonably hope to discover, at some point in the wide territories between Abyssinia and Zanzibar, females of the *Merope* group exhibiting stages intermediate between long-tailed mimetic females of *P. antinorii* and entirely tail-less ones of *P. cenea*.

While dealing with this case, I would add that, until recently, of all the various tail-less continental females of this group known to me, the form *dionysos*—a rare phase of the West African *P. merope*—was the least modified as compared with the male,* for it

* 'Iris,' III., pp. 333–336.

†For colored figures in three forms of *P. antinorii*, ♀, see Haase, *l. c.* II., Pl. I.

*See Trans. Ent. Soc., Lond., 1874, p. 178.

possesses merely a trace of the wide black bar that in two other forms divides the pale ground color into perfectly separate subapical and inner marginal spaces in the fore wings, and the hind wings are ochre-yellow with a narrow black border.* Professor Poulton has, however, kindly shown me, in the Hope Collection of the Oxford University Museum, a much closer approximation to the masculine coloration in an extraordinary example of the female *P. cenea* from Zanzibar. In this female the transverse trace of black in the fore wings is even fainter than in the *dionysos* form, and the color of the wide pale spaces and hind marginal spots in all the wings is almost exactly of the pale creamy-yellowish tint of the male *P. cenea*; and on the under side, while the pale-yellowish of the fore wings is better divided by blackish than on the upper side, the coloring of the hind wings corresponds much more nearly to that of male than in any other female I have seen—the characteristic break in the submarginal brownish band being moreover very complete and wide. There can be no doubt that in this specimen we have a marked case of reversion to the original coloring of the female, but it is unaccompanied by any inclination towards the recovery of the lost tail of the hind wings.

Returning to the general aspects of the subject, it is of importance to consider more closely how the evidence stands in relation to (*a*) persecution by insectivorous foes; (*b*) possession of malodorous and distasteful juices by certain groups; (*c*) rejection or avoidance by foes of the insects provided with offensive juices, and (*d*) loss occasioned to distasteful species by the attacks of young and inexperienced enemies; for it is admittedly on the cooperation of these factors that the theory of mimicry depends.

*Hewitson (Exot. Butt., IV., Papilio XII., fig. 39) delineates an example in many respects intermediate between *dionysos* and *hippocoon*, but rather closer to the latter form as regards the fore wings.

(*a*) As regards the first point, the broad fact of insects generally constituting the food of countless devourers, vertebrate and invertebrate, is beyond dispute; immense and incessant persecution is universally at work. But when we proceed to examine this world-wide persecution more in detail, and to ask in what special directions it works, or what groups or species are the particular prey of certain groups or species of enemies, we very soon discover how little is exactly known. Birds, for instance, are such notorious and apparently indiscriminate insect-eaters, and some of them are so active and demonstrative in their hunting, that it seems but reasonable to regard them as the chief pursuers on the wing of the abundant and defenceless butterflies. Yet in the discussion which followed the reading of Dr. Dixey's last paper, above referred to, nothing was more noticeable than the very scanty testimony to such persecution on the part of birds that could be brought forward by the very competent well-travelled entomologists present. In fact, the poverty of observed cases of such attack has induced the opinion among some entomologists that birds very rarely chase butterflies at all, and the published expression of this view by Pryer, Skertchley, Piepers and other experienced collectors cannot be overlooked. But I am persuaded that in this instance, as in so many others where the life-history of animals is concerned, the dearth of evidence is due to the neglect of well-directed and sustained observation. Little can be gained by merely noting such cases as happen to force themselves on the collector's attention; the collector must resolutely set himself to search out and keep watch upon what really takes place. Considering that there is no record of any naturalist's having seriously taken up the investigation of this matter in the field, I think that very much positive evidence could hardly be expected, and that

what has been published goes far in the direction of proving that birds must still be reckoned among the principal enemies of butterflies. Belt's well-known note on the pair of Puff-birds that he watched for half-an-hour bringing various butterflies to feed their young is supported by E. Poeppig's observation* that in the forest it is easy to discover where a *Galbula's* favorite perch has been chosen, as the wings of large butterflies, whose bodies only have been eaten, strew the ground for several paces round about. Von Wied found a large 'Tagschmetterling' in the stomach of a *Bucco*, and E. Hartert butterflies in that of *Merops pusillus*; while E. L. Arnold saw *Terias hecabe* and *Papilio pammon* caught by birds in India.† Hahnel published in *Iris* (1890) the observation that in South America birds hunted Pierinæ more than any other group of butterflies, and often snapped up specimens close to him. Haase in Siam saw some Catopsiliæ (Pierinæ) and Hesperiidæ captured and eaten by sparrows. I have recorded Mrs. Barber's remarks that among the insects caught and brought to their nestlings by various Sun-birds at the Cape she often noticed *Pyrameis cardui*, and also Mr. Mansel Weale's note that *Tchitrea cristata* captures the male *Papilio cena*. Mr. T. Ayres, a very trustworthy ornithological observer, has remarked (in his notes in *The Ibis* on the habits of South African birds) that the King-hunter, *Ispidina natalensis*, feeds almost entirely on butterflies. Col. Swinhoe informs me that in India he has on several occasions seen *Merops viridis* catch and eat butterflies, and that he has also witnessed many cases of other birds pursuing them; while the common *Corvus splendens* was found greedily to devour any edible butterflies thrown to it. This evidence is supported by that kindly furnished to me by Mr. F. Lewis, of the Ceylon Forest Service, who has for many years been familiar with the ways of birds in the jungle, *vid.*: that he has seen *Merops viridis* and *M. philippinus* occasionally take small white and yellow butterflies (*Terias, spp.*), and the latter bee-eater and *M. swinhoii* frequently capture Catopsiliæ, especially when these butterflies are traveling in thousands along the river valleys. Mr. Lewis also gives *Buchanga leucopygialis* as a very active hunter of butterflies on the wing. In England I have noticed a swallow hunting one of the common 'Whites' (apparently *Pieris brassicæ*), and also three sparrows for some time chase and eventually capture a female *Epinephile janira*; while at the Cape I have seen *Fiscus collaris*, the common shrike of the colony, seize in succession several newly-emerged *Papilio lyæus* on the wing.

In Mr. Skertchley's paper, 'On Butterflies' Enemies,'* he gives a list (p. 485) of no fewer than twenty-three species of butterflies belonging to the different subfamilies, which he observed in Borneo with both hind wings mutilated in the same manner as if a piece had been bitten out while the insect was at rest; but this description of mutilation he attributes, not to the assaults of birds, but to those of lizards and perhaps small mammals. I see nothing, however, to lead us to conclude that birds do not attack butterflies when at rest, especially when settled on flowers, foliage, etc., with closed and erect or pendant wings; it is highly probable, indeed, that they would mark down a settling butterfly and make direct for it. It seems to me likely that most of the destruction of butterflies by birds is not effected by the difficult chase of these wavering and erratic or often very rapid flyers in the open, but is carried on mainly against the slow-flying bulkier females while engaged in depositing their ova, usually among the foliage of trees, un-

* Cited by Haase, l. c., II., p. 104.

† These three cases also cited by Haase, l. c.

* Ann. & Mag. Nat. Hist. (6) III., pp. 477–485 (1889).

dergrowth or herbage, where they would be almost unnoticed by the collectors. An equally, if not more, dangerous time for butterflies of both sexes is during courtship and pairing, when they are less on their guard than at any other period, and those actually paired (unless very well concealed by close resemblance of their under side to the immediate surroundings) have little chance of escape.* Colonel Swinhoe has mentioned to me that birds often do not seem inclined to take the trouble to give chase to flying butterflies, but sit merely watching them, and this is in support of the view that they more frequently adopt the easier plan of attacking them when feeding, settling or at rest. The frequency of the cases where mimicry is confined to the female points with some significance to the probability that persecution is more directed against that sex than against the male.

(*b*) The presence of malodorous juices in many insects is a matter of common observation, and is a protective property possessed by several entire groups, especially among the Lepidoptera and Coleoptera. There is abundant evidence as to the prevalence of these secretions, and among the Lepidoptera they are particularly developed in the butterflies of the groups Danainæ, Neotropinæ, Acræinæ and Heliconinæ, and also in some Papilioninæ, as well as in many moths of the groups Agaristidæ, Chalcosiidæ, Arctiidæ, Lithosiidæ, etc. The strength of the disagreeable odor emitted is in some species very great;† Seitz, for instance, mentioning that that the smell of the South American *Heliconius besckei* and *Eueides aliphera* extends over a radius of several paces, and Wood-Mason and De Nicéville testifying to the same effect as regards the Indian *Papilio philoxenus* and allied forms. When molested many of these offensively-smelling species exude drops of a yellow or whitish fluid which leave on anything they touch a stain and odor difficult to remove, as I have experienced in the case of the Mauritian *Euplœa euphone*, the South African Danainæ, and various South African Agaristidæ, Glaucopidæ and Arctiidæ.

The origin and manner of acquisition of these unsavory secretions have yet to be discovered; the suggestion (so much insisted on by Haase) that these juices are directly derived from those of similar quality in the food plants of the larvæ arising from the long-known circumstance that some of the food plants of species in the protected groups are of an acrid or poisonous character, such as (*e.g.*) Asclepiads in the case of many Danainæ, and Aristolochia in that of the inedible forms of Papilioninæ. No doubt, too, the fact that the unpleasant qualities are very often fully developed in the larvæ of the distasteful species—as I have found with *Danais chrysippus* and various Acrææ—lends some weight to the suggestion; but at present nothing approaching sufficient data can be brought forward respecting the actual food plants to which the protected groups, in contrast to the unprotected, are thought to be restricted. It cannot be gainsaid, as Professor Poulton has pointed out,* that the food plants of many of the distasteful European moths do not belong to any poisonous or acrid category; and his own and Mr. Latter's papers on *Dicranura vinula* alone amply demonstrate what powerful acids can be elaborated by a larva which finds its food in such innocuous plants as poplar and willow. The supposed direct derivation of the nauseous juices from the plants consumed is thus plainly a matter that awaits

*It is not improbably in these circumstances that the imperfectly mimetic but still 'warning' under side of the male in *Perrhybris* becomes specially serviceable (*Cf.* Dixey, Trans. Ent. Soc. 1896, p. 71).

† Cited by Haase, *l. c.*, II., p. 101.

*Proc. Zool. Soc. Lond., 1887, pp. 198, etc., and *Nature*, 4th Nov., 1897, p. 3.

investigation from both biological and chemical standpoints.

(c) The avoidance or rejection as food by insectivorous animals of the insect possessing malodorous or distasteful juices no longer rests merely on the negative evidence given by Bates, Wallace, Belt and other competent observers, to the effect that in nature such distasteful forms are habitually neglected and unmolested; there is now much positive experimental evidence as to the manifest avoidance or disgust with which such species are left untouched, or thrown aside after tasting, when offered to domesticated or captive vertebrate animals that devour ordinary insects with avidity. The numerous experiments of this kind recorded by Butler, Jenner Weir, Weismann, Poulton and Lloyd-Morgan, as regards both larvæ and imagos of European species, are supported by a few made by Belt with Heliconiinæ in Central America, by D'Urban and myself with Danainæ and Acræinæ * in South Africa, and by Haase with Danainæ in Singapore.

It is manifest, of course, that even the most distasteful forms cannot enjoy complete immunity from persecution; in ordinary circumstances they are doubtless mainly kept down by parasitic insects, † and during any scarcity of more palatable prey it is certain that they will be devoured *faute de mieux* by vertebrates and invertebrates alike. To the latter condition are perhaps due such cases as Distant's ‡ note of the orthopterous *Hemisaga* devouring an imago of *Danais chrysippus*; Col. Yerbury's * observation that in Ceylon *Euplœa core* and *Delias eucharis* were largely taken by a Mantis, and *Danais limniace* by two kinds of Asilidæ; and Belt's remark that a flower-frequenting spider captured Heliconiidæ.

(d) As regards the important point whether the protected forms have to suffer a certain percentage of loss from the attacks of young and inexperienced birds and animals, it must be admitted that the evidence at present forthcoming is exceedingly scanty; and I have long felt considerable doubt as to the sufficiency of this factor to account for the mimetic resemblances, often remarkably close, between members of associated protective groups. But on reviewing carefully the recorded observations which appear to bear on the question, I have found reason to think that there is enough support to justify the provisional acceptance of the Müllerian explanation. We have, in the first place, Fritz Müller's own capture of Heliconii and Acræinæ with a notched piece bitten out of the wings, and Distant's (*l. c.*, p. 65) of a *Danais chrysippus* whose wings had been bitten unsymetrically, apparently by a bird. Then there is the significant record of Skertchley (*l. c.*, p. 485) who, among twenty-three species of Bornean butterflies taken with both hind wings mutilated in the same manner, notes no less than four Danainæ, *vid.*, *Hestia lynceus*, *H. leuconœ*, *Ideopsis daos* and *Euplœa midamus*. Moreover, it is very remarkable that several of those entomologists who have specially emphasized the small part played by birds in attacking butterflies mention, among the few cases of such attack as they witnessed, instances of protected forms being assailed, Sir G. Hampson † remarking that in south India the Euplœæ and Danaids were caught as often

* De Nicéville (Butt. Ind., etc., I., p., 318) notes that *Acræa violæ* was the only butterfly rejected by all the species of Mantidæ which he offered various butterflies.

† C. V. Riley (apud Haase, *l. c.*, II., p. 47) found that a dipterous parasite was very prevalent in the larvæ of *Danais archippus*, often destroying a whole brood.

‡ Nat. in Transvaal, p. 65 (1889).

* Proc. Ent. Soc. Lond., 1897, p. xl.

† Proc. Ent. Soc. Lond., 1897, p. xxxvii.

as any others, and M. Piepers* that in two of the four cases which he had seen in Sumatra and Java the species seized were Euplœæ.

The question underlying this is manifestly whether insect-eating animals have an instinctive inherited discernment of what species are unfit for food, or whether, on the contrary, each individual has to acquire this necessary knowledge by personal experience, aided in some vertebrate groups by parental guidance. So numerous and so marvelous are the instinctive or congenital activities of animals—especially in the insect world, where past experience or parental instruction is almost always non-existent—that there has been a very general disposition on the part of naturalists to incline to the former view in a matter so all-important as suitable food. Yet, so far as experiment has hitherto gone in this direction, there seems good ground for holding that—at any rate in such specially insectivorous vertebrate groups as birds, lizards and frogs—the young possess no such hereditary faculty of discrimination, but have to discover individually what to avoid. This appears not only from Mr. Jenner Weir's and especially Professor Poulton's careful and often-repeated experiments with lizards and frogs,† but also from Professor Lloyd Morgan's study‡ of newly-hatched birds of different orders, which indicates clearly with what complete want of discrimination every object of suitable size is at first pecked and tasted, but how soon experience tells and is acted upon. Professor Lloyd Morgan made special trial of these young birds with many distasteful insects and their larvæ, and states in conclusion (*l. c.*, p. 43) that he did not find a single instance of instinctive avoidance, but that the result of his observations is that "in the absence of parental guidance the young birds have to learn for themselves what is good to eat and what is distasteful, and have no instinctive aversions."

In concluding what I feel to be a very incomplete outline of what has been done in this most important branch of zoological research, I cannot refrain from expressing the gratification I find in noting how by far the chief part in the investigations pursued and in the deductions derived from them has from the outset been borne by Fellows of this Society. It is work on which we may with justice be congratulated, and which should encourage perseverance in the same and kindred lines of inquiry.

Here, as in many other biological researches, it cannot be too strongly insisted on that no result of lasting value can be hoped for without resort to the living animals among all the natural conditions and surroundings. It was not a stay-at-home theorist, familiar only with the dried specimens of the cabinet, that detected the meaning of mimicry and gave to science a rational explanation of the mystery, but an ardent explorer and naturalist, who devoted many of the best years of his life to field-work in tropical lands. I am the last to undervalue the knowledge of the systematist, which is absolutely indispensable to all intelligible record, and I fully recognize that no naturalist can be properly equipped for his work without a fair amount of systematic training; but philosophical discovery in any direction such as we are now considering can never be truly advanced without unflagging observation and experiment among organisms living in their environment. How, but by the closest and most exact attention to the entire life-history of animals in their native haunts can we expect to deal satisfactorily with such questions as this of mimicry, of protective resemblances generally, of seasonal dimor-

* Report of Intern. Zool. Congress, III. (Leyden, 1895), p. 460.

† See Proc. Zool. Soc. Lond., 1887, pp. 191, etc.

‡ 'Habit and Instinct,' pp. 29–58.

phism, sexual selection, local variation, and the like? Admitting gratefully the good work of this kind which has been carried on in Europe, and especially in our own country, one cannot but regret that from tropical regions, where alone the abundance, complexity and incessant activity of life afford full prospect of the adequate reward of such research, we have little more than isolated notes and unconnected and incomplete observations, mere indications—precious as they are—of the rich harvest that lies unreaped for lack of resident workers devoted to the task.

It is on this account that I earnestly renew the plea, put forward from this chair on the 5th of May last, for the establishment, in tropical countries, of Biological Stations for the study of the terrestrial fauna; where, as in the existing Marine Biological Stations, naturalists could follow, during a succession of seasons, special lines of observation and experiment under favorable conditions of laboratory and other equipment, free from the hindrances and distractions of ordinary collecting travel, and with all the advantages of mutual help and encouragement. The living expenses, for men of the simple tastes of the naturalist, would not be great; and I feel certain that, with the increasing facilities for swift transport, it would not be long before many students of biology would embrace the opportunity so provided for the effectual prosecution of researches of the utmost value to science.

WILLIAM A. ROGERS.

PROFESSOR WILLIAM A. ROGERS was born at Waterford, Connecticut, November 13, 1832, and died at Waterville, Maine, March 1, 1898. His boyhood was spent for the most part in the interior of New York State, in the villages of DeRuyter and Alfred, where he received his preparation for college. In 1853 he entered Brown University, from which he was graduated in 1857. Before graduation he had already begun his career as a teacher in a classical academy, and immediately after taking his first degree he was appointed tutor in the academy at Alfred, N. Y., from which he had gone forth a few years previously as an exceptionally successful student. In 1859 he was advanced to the professorship of mathematics and astronomy in Alfred University, an institution under the care of the Baptist denomination, of which Professor Rogers was an ardent member throughout his life. This position he held eleven years, though absent part of this time for several specific purposes. Among these absences one was devoted to a year of study in the Harvard College observatory; six months were occupied in work as an assistant in the same place; fourteen months were given to service in the navy during the Civil War; and nearly a year was given to the study of mechanics in the Sheffield Scientific School at New Haven.

In 1870 Professor Rogers severed his connection with Alfred University for the purpose of becoming an assistant in the astronomical observatory at Harvard, and in 1875 he was here made assistant professor of astronomy. This position he retained until 1886, when he accepted the chair of physics and astronomy at Colby University, Waterville, Maine. Here the last dozen years of his life were spent; but had he lived a month longer he would have resumed his connection with Alfred University, where a new physical laboratory is now in process of erection. The building was planned by him in 1897, and on the occasion of the laying of the cornerstone, June 23, 1897, Professor Rogers delivered the dedicatory address. His resignation had already been offered to the Trustees of Colby University, to take effect April 1, 1898.

During the sixty-five years of his busy

life the most distinguishing characteristics of Professor Rogers, as a student and teacher of science, were his indomitable perseverance, industry, care, patience and accuracy. Beginning as a teacher of pure mathematics, he passed naturally into specialization in astronomy and its allied neighbors, mechanics and physics. His delight was minute measurement, with accuracy to the last decimal place that patient industry could render attainable. He sought accuracy not merely for the securing of the best practical results, but because he had a veritable passion for its pursuit. The first time that the present writer came into contact with him was at the Boston meeting of the Scientific Association in 1880, when he gave the outcome of an elaborate comparison between the standard French meter and the imperial yard, the uncertainty being in the value of the digit occupying the place of ten-thousandths of an inch. Another result almost identical with the first was reported in 1882 at Montreal as the outcome of new measurements, the meter being equivalent to 39.37015 inches under standard conditions. Still another was given a year later at Minneapolis, 39.37027 inches. At Philadelphia, in 1884, he announced a re-examination of his data, with the expression of his conviction that this result was a little too high, but that the true value could not be less than that given at Montreal. At Buffalo, in 1886, 39.37020 inches was given as a new determination. In 1893, as the mean of eleven determinations, he gave 39.370155 inches. This may be taken as a final value. It has been subjected to two or more revisions by him since 1893, but with no appreciable change as the result. All physical measurements are necessarily only approximate. There are probably very few of them that have been made with a degree of exactitude superior, or even equal, to this one.

The scientific papers published by Professor Rogers are about seventy in number. The first, which appeared in 1869, was forty-five pages in length, and related to the determination of geographical latitude from observations in the prime vertical. He was at this time about thirty-seven years of age, and still connected with Alfred University, where the facilities for research were very limited. Under his direction in 1865 Alfred Observatory was built and subsequently equipped. His activity as a scientific worker was much stimulated after his connection with the Harvard Observatory became established. During the sixteen years of his residence in Cambridge he published forty scientific papers, most of which related to practical astronomy, such as the determination of star places, the calculation of ephemerides, the study of the errors of instruments, the construction of star catalogues from all known data, etc. Included in such work as this the study of the microscope as an instrument of precision was naturally developed, and the methods of securing accurate rulings for micrometers became a subject for the application of industry. This led Professor Rogers into the study of physical standards of length, and the construction of ruling machines, regarding which he made himself a generally recognized authority. The articles on 'Measuring Machines' and 'Ruling Machines' in the new edition of Johnson's Cyclopedia were written by him.

In all accurate measurements of length the recognition of the temperature at which they are made is a matter of prime importance, since a slight variation in temperature produces a measurable change of length. The recognition of this fact caused Professor Rogers to enter into an extended study of the limits of precision in thermometry, of radiation, and of coefficients of expansion. This continued to be his chief study during the closing years of his life.

Nevertheless, he kept numerous data from his work at Harvard, and published a number of astronomical papers after his removal to Colby University. His special interest, however, had been gradually transferred to the domain of physics. In the construction of micrometers he early experienced trouble on account of the scarcity of suitable spider webs, and this caused him to undertake the etching of fine lines on glass. So successful was he in this that a large number of his plates were secured by the representatives of the national government, and sent out for use by the observers on the occasion of the transit of Venus. During his study of standards of length he visited Europe, obtained authorized copies of the English and French standards, and brought these home with him. They were then used by him as the bases of comparison for bars which he constructed and ruled, and these are now the chief standards in a number of the most important laboratories in America.

Immediately after his removal to Colby University Professor Rogers undertook the study of thirty mercurial thermometers of the U. S. Signal Service pattern, and by comparison with these he secured a standard for the measurement of very low temperatures. It was about this time that Michelson and Morley developed the interferential comparator, and began their investigation regarding the use of the wave-length of sodium as a standard of length. Professor Rogers had already done much work with comparators, and he soon became associated with Professor Morley in the application of optical methods to the determination of minute changes of length. After proper adjustment of apparatus the measurement of almost infinitesimal expansion or contraction becomes possible by merely counting the number of interference fringes of monochromatic light which pass across the field of view in a given period of time. In this way Professor Rogers determined the coefficient of linear expansion of Jessop steel with a degree of precision never before attained. His work in this connection was presented at the Springfield meeting of the Scientific Association in 1895.

In his address last summer at the laying of the corner-stone of the new physical laboratory of Alfred University, Professor Rogers gave a summary of the kind of work which he proposed to undertake personally and with the cooperation of his more advanced students. Prominent among the subjects had in view were the study of the law of expansion of metals under changes of temperature, the standardization of measures of length, the separate measurement of the effects of hot air and of the heat conveyed by radiation, the energy of heat radiations as determined with the interferometer, the development of the construction of precision screws, the practical development of methods of precision in work-shop operation, the investigation of the relative cost and efficiency of small sources of power, of the economy of various methods of heating, and of methods for generation of X-rays. This is an excellent summary of the work to which he had been devoting his energies for some years past.

In acknowledgment of his scientific work Professor Rogers was elected, in 1873, to membership in the American Academy of Arts and Sciences at Boston. In 1880 he received the honorary degree of A.M. from Yale, and during the following year he was made an Honorary Fellow of the Royal Microscopical Society. In 1886 he received the honorary degree of Ph.D. from Alfred University, on the occasion of the semi-centennial of this institution, and in 1892 Brown University conferred the degree of LL.D. In 1895 he was elected to membership in the National Academy of Sciences. In addition to these recognitions of merit he was made Vice-President of the American Mi-

croscopical Society in 1884 and President in 1887; Vice-President for Section A of the Scientific Association in 1882 and 1883, and Vice-President of Section B in 1894. The subject of his vice-presidential address in 1883 was 'The German Survey of the Northern Heavens;' in 1894 it was 'Obscure Heat as an Agent in producing Expansion of Metals under Air Contact.'

Personally Professor Rogers was one of the most unassuming of men, always kindly and considerate in his dealings with others, yet honest and outspoken. With apparently no conception of the meaning of fatigue, he was ever ready to devote hundreds of hours, if need be, to the solution of any problem that he deemed of scientific importance. His time and labor were given freely, with no expectation of reward beyond that which springs from the consciousness of success. He leaves many friends and no enemies, and to the cause of pure science his death is a sad loss.

W. Le C. S.

SIXTH ANNUAL MEETING OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION.

The American Psychological Association held its sixth annual meeting at Cornell University on December 28, 29 and 30, 1897.

For some years the number of papers offered at the meetings has been so great as to crowd the program to a point of serious inconvenience, and as a consequence the experiment was tried this year of holding simultaneous sectional meetings for the reading and discussion of technical papers, a plan which was apparently successful and will probably be followed in the future.

As might be expected from the traditions of the Association, experimental psychology predominated in the number of papers offered, but both general psychology and philosophy were well represented. Two formal discussions were held, one on 'Physical and Mental Tests,' on the 28th, and one on 'Invention,' on the 29th. The President of the Association, Professor J. Mark Baldwin, presided at the meetings.

The opening session was given up to experimental papers, the first being by Dr. J. P. Hylan on 'Fluctuation of Attention.' The speaker presented experimental results and offered the theory that each object of attention innervates certain nervous elements in the cortex, distinct to a considerable degree from those innervated by other objects, and that the comparative exhaustion of one set of elements causes another set to function and the direction of the attention to change or fluctuate in accordance with this change of function.

Dr. Charles H. Judd read a paper on 'The Visual Perception of Depth,' which aimed to show that there is no direct perception of depth by means of the sensations of a single retina unaided by sensations of movement or by binocular factors. The argument was supported by a demonstration of certain visual illusions.

Professor J. McK. Cattell described experiments showing that the time of discrimination increases as the difference in the intensity of two sensations is decreased, and spoke of the application of this principle as a method in psycho-physics. Professor Cattell also described a method for studying muscular fatigue in its relations to mental conditions and exhibited a new instrument for fatigue experiments in which a spring dynamometer is substituted for the lifted weights of Mosso. Results thus obtained were shown which do not altogether confirm those of Mosso.

Dr. E. W. Scripture presented a brief summary of recent investigation at the Yale Psychological Laboratory, the publication of which will follow in the 'Studies' from that institution.

Mr. Albert H. Abbott spoke on 'Color Saturation,' reporting results reached by

experimenting with discs constructed so as to show the same intensity over the whole disc, the same color-tone and a gradual transition from the full color-tone to gray; thus isolating saturation changes.

The following papers of an experimental character were read by title: 'Time Measurements of Visual After-Images,' by S. I. Franz; 'Class Experiments,' by A. Kirschmann; 'Recent Discussion of Color Theory,' by Mrs. Christine Ladd Franklin; 'Experiment in the Psychology of Perception,' by Brother Chrysostom.

The discussion on 'Invention' was led by Professors Royce and Jastrow and Dr. Urban, while Professor Baldwin's presidential address on the related topic, 'Selective Thinking,' which he was unfortunately prevented from reading, was in printed form and in the hands of the members for reference.

Professor Baldwin's paper discussed the material of selective thinking, the function of selection (how certain variations are singled out for survival), the criteria of selection (what variations are singled out for survival) and certain resulting interpretations, treating the problem of race evolution in the light of the author's well known theory of 'organic' selection.

Professor Royce took up the subject of 'The Psychology of Invention' and after defining the problem and, analyzing the general conditions which favor inventiveness, presented interesting results of experiments devised to encourage in simple form individuality and inventiveness. The method chosen was the drawing by the subjects of figures or combinations of curves and straight lines under varying experimental conditions. This paper, as well as Professor Baldwin's, has been published in full in *The Psychological Review*.

Professor Jastrow followed with a paper treating the problem from the point of view of anthropology, and Dr. Urban discussed at some length the limits of the 'Application of the Utility-Selection Hypothesis to Mental Phenomena.'

Two years ago a Committee of the Association was appointed to inquire into the subject of physical and mental tests and to agree, if possible, upon a series of such tests suitable for use with the undergraduates of our universities. This Committee is still at work and in connection with its report this year a discussion was held, opened by Professor Jastrow, with a paper on 'Popular Tests of Mental Capacity.' The speaker took up first the selection of the capacities to be tested and the practical methods of testing them, emphasizing the importance of devising specific typical tests rather than general ones and of obtaining information regarding a single or a very limited group of powers, the advantages of which in the interpretation of results are obvious enough. He then discussed in turn treatment of the senses, the motor capacities and the more complex mental processes.

Professor Baldwin spoke briefly, laying particular stress upon the importance of memory tests, and Professor Cattell, as Chairman, discussed the report of the Committee embodying the results of its work thus far and recommending that a series of tests which can be made upon one subject in one hour be made as far as possible in all psychological laboratories, that a variety of tests and methods be tried and the results reported to the Committee. This Committee, consisting of Professors Cattell, Baldwin, Jastrow, Sanford and Witmer was continued and an appropriation made from the funds of the Association for carrying on its work.

The following papers were also presented at the meeting: 'The Place of Experimental Psychology in the Undergraduate Course,' by Professor F. C. French; 'Concept of Sensation,' by Dr. E. A. Singer, Jr.; 'The Intellectual Content in Dream Con-

sciousness,' by Dr. Robert MacDougall; 'Morality in Child Life,' by Dr. Albert Schinz; 'Professor Titchener's View of the Self,' by Professor William Caldwell; 'Aristotle's Doctrine of ψυχή as Biological Principle,' by Professor William A. Hammond; 'Epistemology and Theories in Physical Science—A Fatal Parallelism,' by Professor A. H. Lloyd; 'Romanes and Mill,' by Professor J. G. Hibben; 'Contributions of Psychology to Morality and Religion,' by Professor J. G. Hume.

Informal communications were also made by several members of the Association.

At the regular business meeting Professor Hugo Münsterberg, of Harvard University, was elected President of the Association for 1898; Dr. Livingston Farrand, of Columbia University, Secretary and Treasurer, and Professors J. E. Creighton, A. Kirschmann and E. B. Delabarre to fill vacancies in the Council.

It was also decided to hold a summer meeting in 1898 at Boston at the time of meeting of the American Association for the Advancement of Science and that the next annual meeting should be at Columbia University, New York, that place having been chosen by the affiliated societies upon invitation from the University.

LIVINGSTON FARRAND.

COLUMBIA UNIVERSITY.

THE AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE seventh session of the Australasian Association for the Advancement of Science was held at Sydney from January 6th to January 14th, under the presidency of Professor A. Liversidge. There was a large attendance and full program, no less than 269 papers being presented before the ten sections.

The President, in his address, after referring to the losses the Association had suffered in the deaths of Sir Robert G. C. Hamilton, Baron von Müller and Professor Parker, gave an account of the work of the Association since its first meeting in August, 1888, under the presidency of Mr. H. C. Russell, when 850 members were present. Since then meetings have been held in Melbourne, Christchurch (N. Z.), Hobart, Adelaide and Brisbane. In referring to the last session at Brisbane, in 1895, he called attention to the research committees then appointed. Chief among these were (1) the committee reappointed for the investigation of glacial deposits; (2) the seismological committee; (3) a committee to consider and report upon the thermodynamics of the voltaic cell; (4) the geology, land flora, land fauna and natural resources generally of the islands and islets of the Great Barrier Reef; (5) the habits of the teredo and the best means of preserving timber or structures subject to the action of tidal waters; (6) the committee to give effect to the suggestions contained in Sir Samuel Griffith's paper, entitled 'A Plea for the Study of the Unconscious Vital Processes in the Life of a Community.' The Association had published six volumes of reports, each of about 1,000 pages. Professor Liversidge then proceeded to give an account of the history, teaching and recent advances of chemistry.

The addresses of the Vice-Presidents before the sections were as follows: *Astronomy, Mathematics and Physics*, 'Astronomy and Terrestrial Physics,' by Mr. P. Baracchi, Government Astronomer of Victoria; *Chemistry*, 'The Constitution of the Matter in the Universe,' by Mr. William M. Hamlet; *Geology and Mineralogy*, 'Early Life on the Earth,' by Professor F. W. Hutton, F. R. S.; *Biology*, 'The Relations of Morphology and Physiology,' by Professor C. J. Martin; *Geography*, 'Submarine Geography,' by Sir James Hector, F. R. S.; *Ethnology and Anthropology*, 'Origin of the Aborigines of Tasmania and Australia,' by Mr. A. W. Howitt;

Economic Science and Agriculture, 'Consumable Wealth,' by Mr. R. M. Johnston, Government Statistician of Tasmania; *Engineering and Architecture*, 'Notes on Some Recent Engineering Experiences,' by Mr. A.B. Moncrieff; *Sanitary Science*, 'Aspects of Public Health Legislation in Australia,' by Hon. Allan Campbell; *Mental Science and Education*, 'The Influence of English History on English Literature,' by Mr. John Shirley.

The report of the Glacial Research Committee, South Australia, was submitted by Professor T. W. E. David and Mr. Walter Howchin. The localities dealt with were comprised within the peninsula which formed the southern limits of the Mount Lofty Range. In 1859 Mr. Alfred Selwyn, at that time Government Geologist of Victoria, whilst travelling through the Inman Valley, discovered a polished rock surface, which, to the practiced eye, exhibited clear proof of glacial action. This was the earliest discovery of its kind in Australia, but the position was lost sight of until re-discovered by the authors of the paper in March last. This polished pavement, which measured over 20 feet in length and 6 feet in breadth, occurred in the bed of the Inman River, a little past the seventh mile post from Port Victor. The glacial beds of the Inman River have at present an elevation of over 600 feet above sea level. If, therefore, the agency of shore-ice as the means of distribution were admitted, they must assume that there had been an elevation of the land since the days of glaciation. The facts were, perhaps, best explained by reference to a combination of agencies, rather than to a single form of ice action.

In presenting the report of the Seismological Committee, the Secretary, Mr. George Hogben, M.A., of Timaru, New Zealand, referred to the work already done in his own colony through the officers of the Telegraph Department, who, on the occurrence of any earthquake shock, filled up certain forms, stating the exact time and duration and such other details of the earthquake as might be useful to the seismologist. By means of these observations the sources of many of the earthquakes had been accurately found, the velocity of propagation determined, as in general rather under 20 miles a minute; in a few cases the depth of the origin was also ascertained, the deepest one found so far coming from a point about 24 miles below the earth's surface. This work has been done in New Zealand since 1889, and the other colonies had been asked to follow suit. This they had done to a certain extent, but the committee was anxious that the system should be developed and made uniform throughout. Of recent work the most interesting item was probably the fact, based upon rough calculations from returns sent by Sir Charles Todd, Professor Bragg and others, that the great South Australian earthquake of May 10, 1897, proceeded from a line parallel to the coast near Beachport and Kingston, and was possibly due to a sliding of one part of the crust upon another, such as forms what was called in geology a 'fault.' This was probably deep, but the later and slighter shocks were surface ones, caused by readjustment of the immediate crust. The subject was still under investigation by the Secretary.

At the final meeting of the General Council the following suggestions from the Recommendation Committee were agreed to: (1) That the New South Wales government acquire the quarry of prismatic sandstone at Bondi, with a view to its preservation as a remarkable geological occurrence. (2) The re-appointment of the Committee on 'The Systematic Conduct of the Photographic Work of Geological Surveys.' (3) A Seismological Committee for 1900. (4) The government of New Zealand to equip Timaru with approval seismological

instruments in charge of Mr. George Hogben. (5) A contribution of £25 towards the preceding object. (6) The appointment of a committee to secure magnetic surveys at the extreme south of New Zealand. (7) Expressing the opinion that the publication of Victorian continuous magnetic records is desirable. (8) That the committee be re-appointed to continue the investigation of the mineral waters of Australasia. (9) That the New South Wales government be recommended to complete the borings at Funafuti while the bore apparatus remains on the island and the bore remains open. (10) A committee be appointed to draw up a list of works and papers relating to Australian flora.

The report from the Baron von Müller Memorial Committee, embodying a resolution, "That the Association places on record its sense of the deep loss sustained by it owing to the death of the late Baron von Müller, and its high appreciation both of his personal character and the distinguished services rendered by him to science," was adopted.

It was announced by Professor Liversidge that communications had been received from the Royal Society regarding the compilation of the Australian portion of an international catalogue of scientific literature, and at the instance of the Chairman an advisory committee, with power to add to its number, was appointed, consisting of representatives from all the colonies. This committee recommended that some recognized society in each colony should collect all necessary matter and forward it to the central bureau, London.

A committee consisting of Professor Lyle, Mr. W. H. Steele and Mr. E. F. J. Love (Secretary), appointed to investigate and report on 'Our Knowledge of the Thermodynamics of the Voltaic Cell,' presented their report.

The usual excursions, entertainments and public lectures were given during the week, and the proceedings closed with a conversatzione given by the Royal Society of New South Wales, at which about 750 guests were present.

Mr. R. L. J. Ellery, late Government Astronomer of Victoria, was elected President for the next meeting of the Association, to be held in Melbourne in the year 1900. Mr. C. R. Blackett, Government Analyst of Victoria, was elected Treasurer, and Professor Baldwin Spenser and Mr. E. F. J. Love, M. A., were elected joint Secretaries. An invitation to meet in Hobart, Tasmania, in 1902 was accepted.

A PLACENTAL MARSUPIAL.

THE discovery by James P. Hill, of the University of Sydney, N. S. W., that the Marsupial genus *Perameles* has a true allantoic placenta, is one of the most important of the many recent advances in our knowledge of the Australian Monotreme and Marsupial fauna. In a recent number of the *Quarterly Journal of Microscopic Science* Mr. Hill contributes his first paper to the embryology of the Marsupials, and describes the relations of the fœtal membranes observed in *Perameles*, as represented in the accompanying figure.

The presence of this organ, which has hitherto been considered entirely distinctive of the Placentalia or Eutherian mammals, in a non-placental, is of great significance, and Dr. Hill concludes his paper by a brief inquiry as to the conclusions which may be legitimately drawn from it as follows: The main question is: has the allantoic placenta of *Perameles* been independently evolved within the limits of the Marsupial order, or is it directly or genetically related to that of the Placentals through the common ancestry of the Metatheria or Eutheria from an earlier Protoplacental stock?

It will be recalled that Huxley, in his

famous paper of 1880, upon the descent of the Mammals, derived the Marsupials from the Monotremes, and the Placentals from the Marsupials. Other writers have disputed this position. Gill had previously united the Marsupials and Placentals as Eutheria. In 1893 Osborn, upon paleontological and odontological grounds, considered the Marsupials as a parallel phylum with the in *Perameles* has led him to adopt the 'parallel' interpretation, deriving both the Placentals and Marsupials from a Protoplacental stock. According to this interpretation, the Marsupials are to be considered in placentation, as in dentition, in a condition of decadence. Thus he says: "In our view, it is unnecessary to trace the placental ancestry of Eutheria back into the mar-

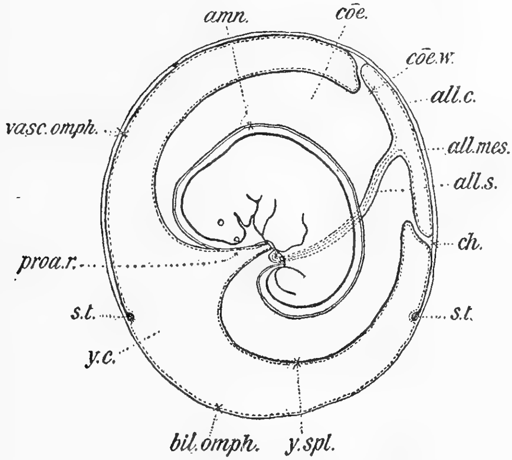

Diagram showing the arrangement of the fœtal membranes in Perameles: *amn.*, Amnion. *all. c.*, Allantoic cavity. *all. mess.*, Allanto-chorionic mesenchyme. *all. s.*, Allantoic stalk. *bil. omph.*, Bilaminar omphalopleure. *ch.*, Marginal zone of true chorion around the allanto-chorionic area. *cœ.*, Extra-embryonic splanchnocœle. *cœ. w.*, Inner or cœlomic wall of allantois. *proa. r.*, Persistent remnant of proamnion. *s. t.*, Sinus terminalis. *basc. omph.*, Vascular omphalopleure. *y. c.*, Cavity of yolk-sac. *y. spl.*, Invaginated yolk-sac splanchnopleure. The ectoderm is represented by a thin line; the entoderm by a dotted line, and the mesoderm by a thick line.

placentals arising from a common stock, and independently differentiated. In a discussion of the tooth development of *Perameles*, Dr. Hill and Professor Wilson, of Sydney, in 1897, advocated the same view. Semon, however, suggested, in 1896, that the Placentals were derived from Marsupials through a *Perameles* and a *Phascolarctus* type, thus supporting Huxley's original position.

Hill's study of the placental phenomena supial group. The occurrence there of a true allantoic placenta, and its absence in the majority of members of the order, do, no doubt, at first sight, suggest that in this group we must find the first beginnings of the organ. But we believe that the explanation is to be found in the fact that marsupials are, after all, a markedly specialized group, and that in it conditions have obtained producing placental disap-

pearance, just as conditions (probably identical in character) have determined the degeneration of other early nutritional arrangements, *i. e.*, the milk-teeth. We, therefore, fall back upon the view that the Metatheria and Eutheria are the divergent branches of a common ancestral stock, which was not only diphyodont but also placental."

H. F. O.

CURRENT NOTES ON ANTHROPOLOGY.

THE TSIMSHIAN INDIANS.

IN 1894 Count von der Schulenberg published in Germany a bulky quarto of nearly four hundred pages on the language of the Tsimshian Indians. Very few people, either in Germany or among ourselves, know where the tribe, of some 3,000 souls, dwells. Dr. G. A. Dorsey, therefore, did a good piece of work when he wrote for the *American Antiquarian* (October, 1897, and reprint) a few pages on their geographical location, and added a map to make it clear. He refers to their myths and names their villages, modern and ancient. He closes his useful article with the common and fateful forecast: "The fate of the Tsimshian, as with his brother elsewhere on this continent, is to disappear."

CAVE HUNTING IN YUCATAN.

UNDER this title Mr. Henry C. Mercer delivered a lecture before the Massachusetts Institute of Technology which has been reprinted from the *Technology Quarterly* of December, 1897. It is a brief description of the work he did in Yucatan as given at length in his volume, the 'Hill Caves of Yucatan.' The lecture is illustrated with half a dozen very well printed photographs, and sets forth clearly the results of his researches.

Mr. Mercer thinks it necessary, toward the close of his lecture, to defend the expedition from the charge of failure. No one could have advanced such a charge who was capable of understanding the value of the results he obtained. He is quite right in vindicating for them an important position in the ancient history of Mayan civilization; though it would probably be going too far to say that they exclude the possibility of finding the traces of 'fossil man' in Yucatan.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

OUR knowledge of the carbids has been decidedly increased by a new series of experiments by Moissan described in the *Comptes Rendus.* It has been known that it is impossible to obtain carbids of sodium, potassium or magnesium in the electric furnace. These are readily formed, however, by heating the metal in acetylene gas. Potassium, indeed, acts on acetylene at ordinary temperatures with the formation of C_2HK, a compound intermediate between potassium carbid and acetylene and which yields acetylene with water. The corresponding sodium compound C_2HNa when heated to nearly the softening point of Bohemian glass decomposes into acetylene, carbon and metallic sodium. Magnesium carbid, similarly formed, decomposes in the electric furnace into carbon and metallic magnesium. The explanation of the impossibility of forming these carbids in the electric furnace is that at so high a temperature the carbid is completely decomposed. Indeed, in the manufacture of calcium carbid, if the current is too strong (in one experiment 60 volts and 1,200 amperes), the calcium carbid formed is decomposed into graphite and metallic calcium, the latter distilling off. Thus the stability of the alkaline carbids is much less than that of the alkaline earthy carbids.

THE fifth edition of the little brochure 'Data concerning Platinum' has just been published by Baker & Co., of Newark, N. J.

In addition to its very full and illustrated description of various forms of platinum apparatus, it has notes on the care and cleaning of platinum ware, and a series of valuable tables which include the current required to fuse platinum wire of different sizes, weight of platinum wire of different sizes and foil of different thicknesses from 0.00045 to 0.1 inch, length of platinum wire per troy ounce, and many others. It is a useful book for the laboratory. The same firm has issued a little booklet—'Platinum: sources of supply, identification and separation of the ore; facts of interest to prospectors and miners.' It is printed in the hope of stimulating a search for platinum in mineral localities and increasing the American supply. From it we take the following: "There are few, if any, of the gold-bearing beds of the world that have failed to yield platinum, and it is more than likely that large quantities of platinum ore have been thrown away with the black sand washings from gold placer deposits." In the list of localities where platinum has been found we note a perpetuation of the old error which includes North Carolina. This, which was based upon a supposed single specimen, was several years ago shown by Professor F. C. Venable, of the University of North Carolina, to be a mistake. In view of the increasing use of platinum, the discovery of further pay deposits of platinum in this country would be of great value.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

DR. W. K. BROOKS, professor of zoology at the Johns Hopkins University, was presented with his portrait on the evening of March 25th, on the occasion of the fiftieth anniversary of his birth. The presentation was made at Professor Brooks' home at Brightside, by Professor W. H. Howell, in the presence of twenty-two of the subscribers. The painting by Mr. Thos. C. Corner is regarded as an excellent likeness. A reproduction will be sent to each of the subscribers, who are for the most part former students of Professor Brooks, and include many of the leading zoologists of the United States. The committee which had the matter in charge consisted of Professor H. H. Donaldson, of the University of Chicago, chairman; Professors W. H. Howell and E. A. Andrews, of the Johns Hopkins University; Professor E. B. Wilson, of Columbia University; Professor H. V. Wilson, of the University of North Carolina; Professor S. Watasé, of the University of Chicago, and Professor T. H. Morgan, of Bryn Mawr College.

DR. TARLETON H. BEAN, Director of the New York Aquarium, has been asked to resign his office by the President of the Park Board. The conduct of the Aquarium under Dr. Bean has met with universal approval, and no reason is assigned for requesting his resignation. There is, in fact, probably none except the wish to secure an office with a salary of $4,000 for an adherent of Tammany Hall.

MAYOR VAN WYCK, of New York, has refused to sanction an appropriation for preparing the site in Bryant Park for the New York Public Library, and there is reason to fear that the new building may be long delayed.

REFERENCE was made in this JOURNAL some eighteen months ago to a subscription to defray the cost of a portrait of Mr. Herbert Spencer to commemorate the completion of his 'Synthetic Philosophy.' The portrait has now been completed by Professor Herbert Herkomer and will be sent to the Royal Academy this year. During Mr. Spencer's life-time it will hang in the Tate Gallery; afterwards, with the approval of the trustees, it will find its permanent home in the National Portrait Gallery.

IT is planned to secure a portrait of Lord Kelvin for the rooms of the Royal Society. Lord Kelvin was, it will be remembered, President of the Society from 1890 to 1895.

WE called attention, in the last issue of SCIENCE, to the memorial in memory of Buys Ballot, the eminent meteorologist. It may be added that Professor Willis L. Moore, Chief of the Weather Bureau, Washington; Dr. A. Lawrence Rotch, of Blue Hill Observatory,

and Mr. R. F. Stupart, Chief of the Weather Bureau, Toronto, are members of the National Committee, and subscriptions may be sent in their care.

PROFESSOR FELIX KLEIN has been presented, on the occasion of the 25th anniversary of his professorship, with an album containing photographs of the present and former members of the Göttingen Mathematical Society.

SIR HENRY BESSEMER, the eminent metallurgist and engineer, who died in London on March 15th, at the advanced age of eighty-five years, should be regarded as a man of science as well as a great inventor. It is interesting to remember that his process for converting cast iron into cast steel was first presented before the British Association in 1856. The essence of Sir Henry's process was simply to blow a blast of air through the molten metal until it was sufficiently decarbonized, and this has been said by a competent authority to be one of the five great inventions of the century. The reduction in the price of steel that has resulted has had an immense effect on modern civilization, it being needful only to refer to the use of steel rails and the consequent reduction in the cost of transportation and to the possibility of erecting buildings twenty stories high. Sir Henry Bessemer could not persuade any manufacturer to use his process and was compelled himself to show its value, fortunately making many million dollars as a result. Sir Henry Bessemer made many other inventions, and spent the last years of his life in devising a reflecting telescope.

THE death is announced of Professor Kirk, of New Zealand, the author of important works on the forests and flora of the colony, and of Dr. F. Hurter, a Liverpool chemist, who had made investigations in chemistry and physics, and of Dr. Jean Valentin, of Buenos Ayres, the geologist.

THE Senate of the University of Glasgow has resolved to confer the degree of LL.D. on Alexander Duncan, B.A., Secretary and Librarian to the Faculty of Physicians and Surgeons, Glasgow; John Inglis, formerly President of the Institution of Engineers and Shipbuilders in Scotland, President-elect of the Institution of Marine Engineers, London; Dr. Elie van Rijckevorsel, of the Batavian Society of Experimental Philosophy, Rotterdam, and John Millar Thomson, F.R.S., Professor of Chemistry in King's College, London.

MR. ALEXANDER AGASSIZ gave a lecture in Saunders Theater, Harvard University, on March 24th, entitled 'The present state of theories of the formation of coral reefs,' giving an account of the important results of his recent investigations of the Fiji Islands.

THE Michigan Academy of Sciences holds its annual meeting at Ann Arbor on March 31st and April 1st and 2d. The address of the President, Professor V. M. Spaulding, was on a 'State Natural History Survey.' The Michigan Schoolmasters' Club holds its annual meeting at the same time and place, scientific subjects occupying a prominent place in the program.

AT a recent meeting of the Boston Scientific Society officers were chosen for the ensuing year as follows: President, H. Helm Clayton; Vice-President, Otto B. Cole; Secretary, Frank A. Bates; Corresponding Secretary, John Ritchie, Jr., and Treasurer, S. N. Norton.

THE anthropological expedition from Cambridge University to Torres Straits, New Guinea and Borneo, to which we have already called attention, left England on March 10th, to be absent fifteen months. Very important results may be expected from the expedition, which is under the charge of Dr. A. C. Haddon, accompanied by six other men of science, peculiarly competent to investigate the natives—their physical characteristics, their mental condition, their folklore, their customs, their amusements, their songs, their language and their condition generally, as affected by their geographical environment.

IN addition to the plans of the Geological Survey for explorations in Alaska, the Treasury Department are about starting five or six expeditions to explore the Yukon river, Copper river and other water routes of the Territory, Congress having appropriated $100,000 for the purpose.

REUTER'S Agency is informed that Mr. H. S. H. Cavendish's proposed expedition to Lake Rudolph and the Nile has been postponed for

the present, after consultation with the Foreign Office.

THE German Meteorological Society will meet at Frankfort-on-Main on April 14th–16th.

THE ninth General Congress of Teachers of the Blind will be held in Berlin on July 25th next. Further information can be obtained from Herr Matthies, Secretary of the Congress of Teachers of the Blind, Steglitz, near Berlin.

A CONGRESS of the Italian Medical Association of Hydrology and Climatology will be held at Parma on April 3d, 4th and 5th.

THE Trustees of the Philadelphia Museums will, at their next meeting, consider the question of establishing branch museums in the principal cities of the Union.

THE National Museum has received from Mr. J. O. Cates, of Port Townsend, Washington, a five-foot example of the remarkable ragfish, *Acrotus willoughbyi*, which was discovered and described in 1887. Another strange fish reported several years ago, but not preserved, was probably an *Acrotus*. The present example, although somewhat mutilated about the head, has been cast and is now preserved in alcohol. Illustrations of this and allied forms are to be seen in Oceanic Ichthyology by Goode & Bean, Pl. LXII.

IT is reported that the German Government is considering the creation of a department of health under a responsible minister, replacing the present medical bureau under the Department of Public Instruction.

THERE is a bill at present before the New York Legislature providing that no patent medicine shall be sold or exposed for sale in the State, unless the formula is printed on the label of the bottle or package containing such medicine, and also on the outside wrapper.

THE Government of India has decided that it is unable to undertake the establishment of a physical laboratory.

M. PHILIPPE PLAUTAMOUR has bequeathed to the city of Geneva 300,000 francs and his estate of Sécheron, which it is expected will be used as a botanic garden.

GOVERNOR BLACK signed, on March 26th, the bill authorizing the establishment of a College of Forestry at Cornell University and appropriating $10,000 therefor. The Trustees of the University are authorized to purchase, with the consent of the State Forest Preserve Board, not more than thirty thousand acres of land in the State park in the Adirondacks for the purpose of establishing the proposed college. The faculty of the college will consist of a professor, two instructors, a forest manager and such rangers, superintendents and other subordinates as may be required. The college will be conducted so as to give instruction and experiment in the latest scientific forestry.

A BILL is before Congress appropriating $25,000 for the purchase of land to be added to the National Zoological Park, Washington, D. C.

THE United States Senate has passed a bill for the protection of song birds, providing that the importation into the United States of birds, feathers or parts of birds for ornamental purposes be prohibited, and prohibiting the transportation or sale of such articles in any Territory of the United States or in the District of Columbia.

THE Prussian Minister of Agriculture, Baron von Hammerstein-Loxten, has issued an official report on the San José scale, setting forth that recently numbers have been found in all stages of development on apples. He adds that it must be presumed that German orchards and nurseries are already infected, and he calls for an immediate and general investigation of the reports and the results.

AT the last meeting of the Council of the Royal College of Physicians, London, a petition was presented from members of the College resident in Italy, asking the support of the Council in protecting their interests as British practitioners in that country in view of the proposed legislation of the Italian Government enacting that qualified medical men of other countries shall not in future be allowed to practice in Italy without holding the degree of an Italian university. It was referred to the President and Vice-Presidents of the College to consider and report thereon.

THERE were 1,259 deaths from the plague during the week ending March 24th.

AT the recent meeting of the Association of

the Chambers of Commerce of the United Kingdom at London a resolution was adopted declaring in favor of the compulsory adoption of the metric system of weights and measures within some limited period of time.

THE House Committee on Coinage, Weights and Measures has reported favorably a resolution authorizing the Secretary of the Treasury to make experiments to determine the best materials for minor coinage and to submit new designs for coins to Congress. It is claimed that the copper cent is undesirable, because it is easily corroded and that the five-cent nickel piece is too soft. It is pointed out by the Committee that Switzerland, Austria-Hungary and Italy have adopted pure nickel for their minor coinage with very satisfactory results, the coins being hard, durable and retaining their color, while not corroding.

A FIRST prize of $15, to be known as the Massachusetts Woman's Club Prize, and a second prize of $10 will be awarded to the public school children in the State of Massachusetts who present the best practical studies on the value of our common toad. The prizes will be given by a committee of Clark University on or before November 1, 1898. All essays must be sent in to Professor C. F. Hodge on or before October 1st.

THE regulations for the Gedge prize, Cambridge University, founded by a bequest of £1,000 by the late Mr. Joseph Gedge, M.B., of Gonville and Caius College, have been announced. The prize is to be offered for competition in every second year and to consist of the interest on the capital sum. It is to be awarded for the best original observations in physiology or in any branch thereof, that is to say, in histology, physiological chemistry or physiological physics, the word physiology being used in a wide sense. Candidates have to be members of the University who during six terms subsequent to the beginning of the term of their matriculation have studied in the University laboratories or attended University lectures, and who at the time of the award of the prize are of not less than five years' and not more than seven years' standing from matriculation.

Nature quotes from the *Rendiconti del Reale Istituto Lombardo* the conditions of the prizes offered for competition in 1898 and 1899. Most of these prizes are open to all nations; but the essays must be written in Italian, French or Latin, and forwarded under a motto to the Secretary of the Istituto Lombardo, Palazzo di Brera, Milan. The prizes of general interest are the following: (1) The Institute's prize of 1,200 lire for the most complete catalogue of extraordinary meteorological events from the most ancient times down to 1800, excluding auroras and earthquakes, which have already been catalogued. Last date, May 1, 1899. (2) The Cagnola prize of 2,500 lire and a gold medal (value 500 lire) for a critical review of the theory of electric dissociation, with new experiments. Last date, April 30, 1898. (3) The Brambilla prize of 4,000 lire to whoever shall have introduced into Lombardy the most useful new machinery or industrial process. Names to be sent in by April 30, 1898.

THE *British Medical Journal* announces that the services of Surgeon-Major Ronald Ross have been placed at the disposal of the Surgeon-General with the Government of India, in order that he may undertake a special inquiry as to the relation of the mosquito to the hæmatozoon of malaria. Surgeon-Major Ross has already done very important work on this subject, and it is not too much to hope that, with the special opportunities which will now be afforded to him, he will be able to clear up the question. Should he be able to establish on a sure basis the theory that the mosquito is the extracorporeal or alternative host of the malaria parasite a great step in advance will have been made. It may not improbably render possible an intelligent prophylaxis against malarial fevers for in no department of human activity is it more true that 'knowledge is power' than in that of preventive medicine.

A JOINT committee of the Parks and Open Spaces Committee and the Technical Education Board of the London County Council has been considering the practicability of laying out plots of ground in certain of the London parks in such a manner as will afford assistance to scholars at elementary and secondary schools in

the study of practical botany. According to the London *Times*, reports have been presented to the committee on the educational side of the question by Dr. Garnett and Dr. Kimmins. The following suggestions were contained in these reports: 1. That a very valuable experiment could be conducted on a scale sufficiently wide if, in each of three parks, about 20 rods of ground were devoted to the cultivation, for school purposes, of hardy typical plants belonging to 20 natural orders. 2. The beds should be arranged near the paths, one bed being devoted to each order. They should differ in size, the largest being a little under 500 feet square, and the smallest about 100 feet square in area, so that the average of the 20 beds would be approximately one rod. 3. The specimens selected should be such as are suitable for growth, and each should be labelled with its common name and its Latin, or systematic name. 4. Labels giving the names and natural orders should be attached to the more important trees, shrubs and plants throughout the parks selected. 5. A botanical guide to the parks selected should be published under the superintendence of the Technical Education Board and the Parks Committee jointly. 6. Teachers holding printed orders from the Technical Education Board should be able to obtain from the superintendent in each park such specimens as might be required for botanical study in the schools, so far as they could be applied without detriment to the specimens. In a report upon the matter the Parks and Open Spaces Committee adopt these suggestions, and, putting them in the form of recommendations, will shortly submit them to the County Council for approval. They point out that some further suggestions were made, but they thought it would be better in the first instance to deal with the subject quite in the sense of an experiment, and if, later on, it should prove to be resulting advantageously to the schools, possibly the arrangements might be extended to the cultivation of important types of the lower orders of plants, such as fungi, mosses, ferns, etc., and facilities might be afforded for the study of aquatic plants. The chief officer of the Parks Department reported that the pro- ed arrangements were quite practicable at any of the larger parks, but that some expenditure would be necessary. Upon that point the chief officer has been instructed to submit a report. It is proposed that the experimental beds shall be formed at Battersea-park, Ravenscourt-park and Finsbury-park.

UNIVERSITY AND EDUCATIONAL NEWS.

THE will of the late Jacob Tome gives the residue of his estate, estimated at $3,000,000, to the Jacob Tome Institute of Port Deposit, Md., which during his lifetime he had founded and richly endowed.

THE Maryland Senate has passed a bill appropriating $50,000 a year for two years to Johns Hopkins University. It is to be hoped that the bill will be passed by the House, which, as we stated last week, rejected the bill appropriating $100,000 to the University.

HON. CHESTER W. KINGSLEY has given the Worcester Academy $25,000 to complete the sum needed to defray the expenses of the new Kingsley Laboratory, to the dedication of which we referred recently.

IN a letter to the Board of Visitors of the University of Virginia, Charles B. Rouss, of New York, says: "I hereby send you my check for $10,000. Having been informed that the $25,000 previously donated by me was not sufficient to complete the physical laboratory building which bears my name, and being unwilling to permit anyone else to have part in a work which I consider to be my special privilege, I desire so much of the sum sent as may be needed to be used in liquidating the balance due on the cost of the building, the remainder to be added to the equipment fund."

THE Trustees of the Teachers' College, Columbia University, announce the foundation of five fellowships of the value of $500 yearly; and carrying the privilege of free tuition, and ten scholarships of $150 a year, each to be awarded annually; to be tenable for one year, and to be designated respectively as Trustees' Fellowships and Trustees' Scholarships. These fellowships and scholarships will be awarded to applicants who give evidence of special fitness to undertake courses of higher study and original investigation in education. Two new scholarships

for undergraduates are announced, viz., the Charlotte Louisa Williams Scholarship, founded by Mrs. Peter M. Bryson and Miss Grace H. Dodge, which is tenable for one year, yields $150 a year, and is for women, and the Earle Scholarship for men, also awarded annually, and worth $150 a year.

MR. WILLIAM HOULDSWORTH has given the University of Glasgow property yielding an income of £150 a year for a fellowship in physics. *Nature* states that Mr. Houldsworth has taken this method of showing his interest in the welfare of the University and the advancement of science, and his recognition of the distinguished services rendered to scientific research by Lord Kelvin during a professorship of fifty years.

MAGDALEN COLLEGE, Oxford, will award, in October, a fellowship in medical science.

THE seventh summer session of Cornell University will be held from July 5 to August 13, 1898. An announcement of the courses of instruction, just issued, shows that fourteen departments of study will be represented, including mathematics, physics, chemistry, botany and experimental engineering.

ACCORDING to the daily papers Mr. James M. Davis, of St. Louis, has 'bought' Garfield University at Wichita, Kan., and will present it to the Society of Friends.

THE London University Commission Bill has been read for the second time in the House of Lords.

PROFESSOR WILLIAM W. BIRDSALL, now Principal of Friends' Central School of Philadelphia, has been elected President of Swarthmore College, to fill the vacancy made by the resignation of President Charles De Garmo, lately appointed to the position of head of the pedagogical department of Cornell University.

CHANCELLOR C. M. ELLINWOOD, of the Wesleyan University, Lincoln, Neb., has resigned, and Dr. D. W. C. Huntington has been made Chancellor temporarily.

DR. W. J. SIMPSON, late health officer of Calcutta, has been appointed professor of hygiene in King's College, London.

KING'S COLLEGE, Cambridge, has elected to professional fellowships Mr. James Alfred Ewing, M.A., F.R.S., professor of mechanism and applied mechanics, and Mr. A. A. Kanthack, M.A., professor of pathology.

THE professorship of surgery at Cambridge University has been suspended for the present and a reader will be appointed. The lectureship in geography will be made a readership, the Council of the Royal Geographical Society having continued the annual grant of £150 for a term of five years. To this grant the University adds £50.

PROFESSOR BASTIAN has retired from the chair of clinical medicine in University College, London, after a service of twenty years.

MME. MADELEINE LEMAIRE, the flower painter, has been appointed professor of botanical drawing at the Jardin des Plantes, Paris.

DR. K. GROOS, of Giessen, has been appointed professor of philosophy at Basel.

DR. PH. LENARD, assistant professor of physics in the University of Heidelberg, has been called to the chair of physics at Kiel.

DR. A. SAUER, docent in mineralogy, and Dr. Bela Haller, docent in zoology, have been promoted to assistant professorships in the University of Heidelberg.

DISCUSSION AND CORRESPONDENCE.

THE LONGEVITY OF SCIENTIFIC MEN.

IN the *Cosmopolitan Magazine* for March, I quoted from the *Popular Science Monthly* of May, 1884, certain statistics with regard to the longevity of astronomers from Dr. A. B. Lancaster, who derived his data from the records of 1741 astronomers as given in Houzeau and Lancaster's 'Bibliographie générale de l'astronomies.' Lancaster's figures agree, in a general way, with those given by Quetelet in his 'Anthropometrie,' and with those given by Riccardi in his 'Biblioteca mathematica Italiana.' In SCIENCE for March 18th the editor objects to Dr. Lancaster's conclusions and points out what he supposes to be an error of method on Lancaster's part. In fact, his own method is identical with Lancaster's. Their data are quite different, however. The difference in results depends entirely upon the difference of data. Dr. Lancaster assumes that an astronomer 'begins his career,' and deserves

a place on the list, at the age of 18 years. The editor, on the other hand, fixes the age at 40 years. Professor Jastrow in SCIENCE, volume 8, fixes the age in question at 37 years. We have thus three opinions as to the data and, naturally, three results. After examining these three opinions I venture to add a fourth—namely, that the age fixed by Lancaster is too low; that the editor's is much too high and that Professor Jastrow's is somewhat too high. Jastrow's conclusion is: "Men of thought live 69.5 years, or 3.5 years longer than ordinary men, while the lives of men of feeling [poets, musicians, artists, etc.] are three years, those of men of action five years shorter than those of average men." These statements show 'that the kind of psychical and physical activity influences the life period.' Quantitative results in this matter are only to be reached after a critical study of the data. Neither Lancaster nor the editor have made such a study. The assumption of Professor Jastrow is so based, but the details of his processes are not given. I am inclined to think that for astronomers his figures are too low.

EDWARD S. HOLDEN.

MARCH 20, 1898.

TO THE EDITOR OF SCIENCE: In the matter of the longevity of scientific men, I should like to direct the attention of your readers to an article which I published in SCIENCE of October 1, 1886 (reprinted in *Nature* November 4, 1886). I there considered the erroneous conclusions as to the longevity of astronomers and mathematicians, which Professor Holden has recently revived. Inasmuch as I had available in the case of a considerable number of great men the approximate date at which they accomplished work, which would presumably entitle them to a place on this list, I was able to compare more exactly the average longevity of these great men with the average longevity of ordinary men who had reached a similar age. This age I found to be about 37 years, which, with the expectation of life at that age, namely 29 years, would make the age at death 66 years, which was precisely the age at death of the great men selected for this comparison. It is quite possible that men of science live longer than other great men; but, if so, it would, of course, be only a very modest increase of years consistent with the known laws of variation.

JOSEPH JASTROW.

UNIVERSITY OF WISCONSIN,
March 20, 1898.

SCIENTIFIC LITERATURE.

A NEW EDITION OF ECKER'S FROG.*

THERE is probably no single animal, man excepted, which is more studied than the frog. It can be had in quantities; it presents the characters of the vertebrates in a comparatively simple condition, and hence it is used in every zoological course, while the vitality of its tissues renders it of extreme value to the physiologist. Naturally, such a useful animal has been the subject of considerable literature, and outlines of its structure will be found in almost every laboratory manual. Most of these, however, present only outlines, but in 1864 Alexander Ecker, then professor of anatomy in the University of Freiburg, began the publication of what was intended to be an exhaustive account of the anatomy of the common frog of Europe. Ill health, and finally death, prevented his completion of the work, but it was taken up and carried through by Wiedersheim, who succeeded Ecker in the anatomical chair, the final part appearing in 1882. Later (1889) an English edition of the work appeared, but this was more than a translation, for its editor, Dr. George Haslam, left his impress on every chapter, his changes in some instances amounting to a complete revision of certain sections.

Now a new German edition is in process of publication, and it is interesting to note that the new editor, like his predecessors, is connected with the anatomical institute of the University of Freiburg. Professor Gaupp began his studies of the frog in 1892, and since that time most of his publications have related to that animal, its skeleton and its muscles; especially noteworthy

*A. Ecker's und R. Wiedersheim's Anatomie des Frosches auf grund Untersuchung durchaus neu bearbeitet von Dr. Ernst Gaupp. Erste Abtheilung, dritte Auflage. Braunschweig, Vieweg und Sohn. 1896. Pp. x+229. Zweite Abtheilung, erste Hälfte, zweite Auflage. Brunschweig. 1897. Pp. ii+234. 22 Marks.

being his contributions to our knowledge of its cartilaginous skull. Two parts of the new edition have been published so far, one dealing with the skeleton and the muscles, the second with the nervous system.

In dealing with the bony frame-work of the frog one would naturally expect but few changes; since the time of Dugès these parts have been pretty accurately known. In certain places, as in the treatment of the wrist and ankle, the matter in this edition is much changed, while here and there minor changes are noticeable. Thus the name of the anterior end of the sternal structures has been changed from omosternum to episternum, but without (in spite of what appears on pages 31 and 32) sufficient justification. It has yet to be shown that the element in question is homologous with the episternum of Stegocephali, Reptilia, etc. Again we do not like the substitution of 'parabasal' for the well-known term parasphenoid (p. 50), or that of quadrato-maxillaria (p. 55) for the quadrato-jugul. Bardeleben will be pleased with Gaupp's acceptance of the prehallux as a veritable sixth toe.

More noticeable than these points in this section on the skeleton is the space given to the chondrocranium,* a subject which Gaupp has made peculiarly his own. Descriptions are given of these parts in the young and in the adult.

In the section on the muscles the changes are more numerous, names being altered in many instances so as to show more clearly the homologies with the musculature of man. In many places, noticeably with regard to the muscles of the abdomen and of the feet, the changes are more marked, as in these regions Dr. Gaupp has differentiated the muscles to a greater extent than has ever been done before.

The part upon the nervous system, embracing no less than 234 large octavo pages, over half of them in fine print, shows the greatest change. In fact, it is hardly possible to compare this portion of the work in the two editions. This change was certainly to be expected when it is recalled that no discoveries in the last fifteen years equal those in relation to the structure of the brain and nerves. The Golgi and methylene blue methods have let no little light into this most complicated part of vertebrate anatomy.

*Gaupp, like most Germans, calls this the primordial cranium. It is better to restrict this term to the membranous envelope of the brain which precedes the cartilaginous skull.

Dr. Gaupp adopts throughout the neural terminology of the German Anatomical Society, which, backed as it is by some of the best anatomists of the world, will probably have wide acceptance, although some of its features seem needless. Dr. Gaupp has given us not only an account of those features in the nervous system which can be made out by ordinary dissecting methods, but one of the clearest summaries of the internal structures with which we are acquainted. The student who has been troubled in trying to understand the complicated relations of fibre-tracts, ganglia, 'nuclei,' fasciculi, commissures, deeper origin of cranial nerves and other like questions should follow through the matter detailed in these pages, where he will find summed up not only the studies of Burckhardt, Edinger, Köppen, Ramón y Cajal, Sala, Studnička, etc., but the investigations of the author himself. The peripheral and sympathetic systems are treated with equal thoroughness and their distribution traced with a detail far beyond that in any previous work on the frog; and the chief point on which we could desire more information not given in this work is a study of the nerve components such as Dr. Strong has given us for the tadpole. On almost every page we find a feature lacking in the previous editions—comments on the morphological bearings of the facts presented. Where there is so much and where all is so well treated it is difficult to select any one part for special mention. We can hardly hope that the whole work will be translated into English, but we wish that these pages on the nervous system could be put into available shape for the American student, for they form a most admirable introduction to neurological studies, and for many years no work upon the nervous system of the Ichthyopsida can be undertaken without extended use of Dr. Gaupp's summary.

In its mechanical make-up the work is attractive. The typography is good and the subordi-

nation of headlines, etc., is consistent throughout. The illustrations have been largely redrawn, and the frequent use of color in them render them more intelligible. Why is it that American publishers insist in using a thick and heavy paper in their publications? Certainly thin paper like this (the 460 pages are but three-quarters of an inch in thickness) has numerous advantages. A final word, which may interest some, is that the German is clear and simple and does not require extensive linguistic attainments and capacity for unravelling involved sentences for its perfect comprehension. The section on the circulatory system is promised for this year. We await its appearance with the highest anticipations.

J. S. KINGSLEY.

A Laboratory Manual in Practical Botany. By CHARLES H. CLARK, A.M., D. Sc., Principal of Windsor High School. New York, American Book Company. 1898. Small 8vo. Pp. 271.

It is significant of the change which has come over the teaching of elementary botany in this country that the publishing house which has for many years issued the text-books which perpetuated the old method of presenting the subject has at length found it desirable to bring out a book written along modern lines. The author has been known for some time as the writer of a handy book of practical methods in microscopy, but has not been known as a worker in botany. He has adopted that laboratory method which has commended itself to many teachers—namely, of first presenting a summary statement including the principal features of the plant in hand, and following it by a series of 'practical studies' in which the pupil is not told too much, but is led to make independent observations.

After a rather long and quite needless preliminary chapter there follow chapters on 'Slime Molds' (Myxomycetes), Diatoms, Fission Plants, Algæ, Fungi, Bryophytes, Pteridophytes and 'Spermaphytes.' The general sequence is therefore quite good, since it is in accord with that usually adopted in modern works. In a general way, we may say that the presentation is good, also, the plants selected as examples being those commonly regarded as fairly representing the larger groups. It is unfortunate, therefore, that in the compilation of this book the author could not have had the aid of a botanist well acquainted with the various groups of plants treated. The failure to do this has led to many errors of statement, doubtless due to a misunderstanding of the subject in the labor of compiling from various texts.

In order that this book may be a safe guide, there are numerous errors and slips which will need correction. When we add to the direct errors a looseness of statement which too often mars the pages we have ample reason for asking for a revision before too much harm has been done. Thus it is inexcusable to call the ear of corn with its husks a fruit (p. 30), and to say that Spirogyra is one-celled, the cells being held together by a gelatinous coating (p. 41). We all once said that the Siphoneæ were one-celled, as the author still does (p. 72), but we know better now, and the same may be said regarding the fusion of the 'sporidia' of Ustilagineæ (p. 122), not now regarded as a sexual act. So, too, it is an error to say that stomata first appear in Pteridophytes (p. 184), good ones occurring on the moss sporophytes, and that the macrospores of Spermatophytes are borne in embryo-sacs (p. 205). The directions for the sectioning of the youngest pine cone (p. 209) are radically wrong, since at this time there is neither 'embryo-sac' nor 'endosperm' present, while fertilization does not occur until a year later.

A few examples of loose and inexact statement will suffice to show how seriously the book offends in this direction. Thus, on pp. 9, 10, "Another fact which distinguishes the Thallophytes is that the female gamete is never an archegonium, while in all other groups it is essentially an archegonium;" p. 12, "The terms *group*, *branch*, *class*, *order* and *family* are variously and arbitrarily used by writers;" also (p. 40), "different varieties may be found," where the author means 'different species;' still, again (p. 79), 'is the best known plant of its *class*,' here evidently intended to refer to its *order* or *family*. There is no excuse for a description of a fern prothallium as 'a small thalloid leaf' (p. 185), nor for the description

of gymnosperms (p. 206), which is based entirely upon the structure of the pines alone.

A few blunders of another kind mar the book, as 'protonemæ' (p. 10 et seq.), 'barbarous Latin and Greek names' (p. 8), 'female macrospores and male microspores' (p. 186), 'botanies' (p. 208). It is quite unpleasant also to see chlorophyl for chlorophyll and spermaphytes for spermatophytes.

There are many excellent features about this book, and both author and publishers owe it to themselves to see that the grave defects of the kind indicated above are speedily corrected.

Charles E. Bessey.

Elementary Botany. By Percy Groom, M. A. (Cantab. et Oxon.) F. L. S. London, Geo. Bell & Sons. 1898. With 275 illustrations.

This concise and attractive volume of 252 pages is designed by the author to meet the requirements of secondary schools in England. As suggested in the preface, "though by no means a 'cram-book' for elementary examinations, a thorough knowledge of the contents of this book will enable a candidate to pass with distinction." Perhaps such a sentence will indicate a certain difference in educational conditions between England and America, for here it would not be easy to select any two hundred and fifty pages of botanical exposition and guarantee, upon its proper assimilation, a 'pass with honor.' The reason probably lies in the greater conservatism of the English school curriculum and the firm adherence of the English teacher of botany to the traditions of earlier days, when the systematic study of flowering plants filled a larger horizon than it does at present. When one understands the clientèle for which Groom's Elementary Botany was written it must be acknowledged to be an extremely good book. It is clear, crisp, accurate, not technical enough to be dry, nor untechnical to the point of looseness. It comprises in astonishingly small compass an adequate account of general organography, metaspermic taxonomy and elementary physiology. The figures, many of them original, are nearly all distinctly good and are far above the average of those presented in most books of similar purpose. The original figures are some of them real additions to botanical iconography, as, for example, figs. 49–52, illustrating the yearly history of the common crocus.

One is impressed by the thorough modernness of the writer of this little text-book in many small bits of detail scattered through the work, some of which might easily escape the reader. The definition and classification of fruits, the account of floral morphology and even the definition of the flower are suggestive. The reviewer has always insisted upon the necessity of the most careful definition and can conscientiously congratulate Mr. Percy Groom on his success in one or two difficult points. Sometimes, however, there is a little vagueness. It would, perhaps, be too much like trifling to call attention to a sentence on the first page—"A fern seems very unlike a mushroom and yet both are alike in that neither of them possesses flowers." This seemed to suggest an old riddle—"Why is a horse like an oyster?" —to which the very obvious answer is, "Because neither can climb a tree." Such absurd collocation of ideas would naturally not occur to the English users of this work, and the author cannot be blamed for not protecting himself against manifestations of a well-known American failing.

Some reviewers will doubtless object to the multiplicity of definitions in the Elementary Botany, but in so doing will scarcely do more than indicate their ignorance of the English school system. Where examination has been reduced to a science, as in England, and where secondary education has so thoroughly crystallized in well-marked grooves, this type of text has a place of its own and in the belief of the reviewer fills it admirably.

Conway MacMillan.

An Introductory Course in Quantitative Chemical Analysis. By Percy Norton Evans, Ph.D., Associate Professor of Chemistry, Purdue University. Ginn & Company. 1897.

The number of guides or manuals to qualitative analysis is very great, as nearly every teacher of that subject publishes a book arranged according to his ideas, although the material is practically identical. The field of quantitative analysis has not been so well covered. The student is generally directed to

make certain analyses, and is referred to one of the large text-books for details. A beginner is bewildered by the complexity of the work, and ends by becoming a mechanical agent, following detailed directions without knowing or inquiring why certain courses of procedure are necessary. The author has arranged a course which will serve as an introduction to the subject and give the student an excellent working basis for more advanced work in this line. He has selected typical methods in both gravimetric and volumetric analyses. In a section devoted to miscellaneous analyses he gives general directions for the analysis of such things as silver coins and rocks, and refers the student to larger works for details. The directions are clear and logical, and the reactions which take place in each case are given; but the author has purposely omitted some details, as methods of filtering and other manipulations, as he considers that these should be learned by the student from demonstration by the instructor. This book will no doubt prove valuable to those beginning work of this kind, and especially for those who are desirous of obtaining a general idea of the methods used in quantitative analytical work.

J. E. G.

A Laboratory Guide to the Study of Qualitative Analysis. By E. H. S. BAILEY, PH.D., Professor of Chemistry in the University of Kansas. Hudson-Kimberly Publishing Company. 1896.

The author states in his preface that he cannot hope to offer anything especially new or original, but his aim has been to present the subject in as concise a form as possible. The general arrangement is similar to that of many other works on this subject, and the author acknowledges the assistance he received from them. Each group is studied in detail, the principal soluble and insoluble compounds being described and the methods given for the separation of the members of the group.

J. E. G.

Repetitorium der Chemie, mit besonderer Berücksichtigung der für die Medizin wichtigen Verbindungen, sowie des 'Arzneibuches für das Deutsche Reich' und anderer Pharmakopöen, namentlich zum Gebrauche für Mediziner und Pharmazenten. Bearbeitit von CARL ARNOLD, Professor der Chemie an der Königlichen Tierärztlichen Hochschule zu Hannover. Achte verbesserte und ergäntze Auflage. Hamburg und Leipzig, Verlag von Leopold Voss. 1898.

The author, in his preface, says that this book is chiefly intended to prepare medical students for the government examination in chemistry. The first edition was published in 1884. Eight editions in thirteen years seem to indicate that the book fulfills its purpose. A careful examination fails to show why it is popular. The crude facts of methods of preparation of chemical substances, and the properties of the elements and compounds, are carefully separated from the chemistry which would make these facts intelligible and interesting. Under the title 'Allgemeine Chemie' the author gives forty-two pages of bald, concise statement. He gives in the next 230 pages dry facts concerning elements and inorganic compounds, with scarcely an illustration or illuminating thought. The last and longest section, 275 pages, is devoted to organic chemistry; the nature of the subject compels the author to treat it more intelligibly than the inorganic part, but light is admitted sparingly and under protest.

It is only fair to say that as a compend of facts the book is both full and concise. The student who could memorize it all, with some explanation from a competent coach, would have a mass of information which would be of excellent service to him when he should begin the study of chemistry.

The popularity of this book suggests speculation as to the nature of the German government chemical examination for medical students. To the lay mind it would seem that when with at least one well-known and excellent Repetitorium—Pinner's—written for the same purpose, for sale everywhere in Germany, this present compilation finds favor, the government examiners must demand crude statements of facts—not chemistry. Many of the well-known English quiz compends on chemistry are just as heavy and wooden; but we know that the universal cramming for government examinations in England is nowhere more condemned and deplored than by English chem-

ists, who refer to the study of chemistry in Germany as the model to be copied.

It would be an interesting occupation for a retired chemist, of statistical mind, to make a collection of government chemical examination papers in all countries, and of the compends used in cramming for the examinations; then to see whether the dryness of the systems is local or general. E. RENOUF.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON—289TH MEETING, MARCH 12.

DR. C. W. STILES presented some 'Practical Suggestions in Regard to Trichinosis,' briefly reviewing the methods of pork inspection in vogue in Germany.

Dr. Erwin F. Smith spoke on 'Migula's System der Bakterien,' stating that Migula was the first to classify bacteria on morphological instead of physiological characters. He briefly outlined the groups and genera adopted, giving the characters on which they were based.

Dr. F. C. Kenyon, under the title 'Some Recent Advances in our Knowledge of the Nervous System,' briefly reviewed the general structure of the nervous system of arthropods. The fact was brought out that the so-called nerve cell is situated on the outside of the system, thus resulting in the formation of a nerve element comparable with the spinal ganglia of mammals. This so-called nerve cell was given the name of cytosomite, and the process leading from it into the nervous system was denominated the caulite, the remaining portions of the element being considered as neurite and dendrite. The distinctions between these was based upon function and the nerve element compared to a Leyden jar, of which the neurite was held to be the recipient part, and the dendrite the discharging part, for all neural impulses. In the case of the dendrite, however, this distinction may be faulty, since dendrites occur whose relations seem to indicate that they must function both as recipient and discharging parts. It was thought that the arthropod cytosomite and caulite do not function in the transfer of neural impulses, since they lie to one side of what seems to be the most direct route. The neurocyte, or nerve element, was briefly defined and the different types of neurocytes to be found in the nervous system of arthropods briefly described and commented on. The paper will be published in full later on. F. A. LUCAS, *Secretary.*

AMERICAN CHEMICAL SOCIETY, JANUARY 13.

THE fourth annual meeting of the Washington Section of the American Chemical Society was held on January 13th. The following officers were elected for the ensuing year: H. N. Stokes, President; Peter Fireman and H. Carrington Bolton, Vice-Presidents; William H. Krug, Secretary; W. P. Cutter, Treasurer, and C. E. Munroe, E. A. de Schweinitz, Wirt Tassin and W. F. Hillebrand, additional members of the Executive Committee.

The regular February meeting was held on Thursday evening, February 10th. Mr. Tassin presented a paper on 'The Origin of Crystals and Crystalline Growth,' which contained a *résumé* of theories concerning the origin of crystals and the processes of crystal-growth, and consisted of a discussion of the results of the researches of Vogelsang, Behrens, Knop, Sadebeck and Lehmann.

Dr. H. Carrington Bolton read a paper entitled 'Iatro-Chemistry in 1897,' which was published in full in last week's issue of SCIENCE.

Dr. H. W. Wiley addressed the Society on the subject of pure food legislation, and discussed the benefits which would undoubtedly result from the deliberations of the Pure Food Congress, which will assemble in Washington on March 2d. WILLIAM H. KRUG, *Secretary.*

NEW BOOKS.

Quantitative Chemical Analysis by Electrolysis. ALEXANDER CLASSEN, in cooperation with DR. WALTER LÖB; authorized translation by W. H. HERRICK and B. B. BOLTWOOD. New York, John Wiley & Sons; London, Chapman & Hall. 1898. Pp. 301. $3.00.

Reform of Chemical and Physical Calculations. C. J. T. HANSSEN. London and New York, Spon & Chamberlain. 1897. Pp. 72.

Einfühlung und Association in der neueren Aesthetik. PAUL STERN. Hamburg und Leipzig, Leopold Voss. 1898. Pp. viii+81. M. 2.

SCIENCE

FRIDAY, APRIL 8, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE MATHEMATICAL THEORY OF THE TOP.**

LOOKING over such famous old books as Montmort's 'Analyse des jeux de hasard' or Moivre's 'Doctrine of Chances' one regrets that so much excellent mathematics should have been wasted on games most of which are wholly obsolete. Coriolus in his 'Jeu de billard' (1835) fared better, for the game is still very much alive and its dynamical terrors unsubdued. In even greater measure is this true of the top. The top has been everybody's toy and must, therefore, at one time or another have piqued everybody's curiosity. Lagrange, Poinsot, Jacobi, not to mention other great names, have in their turn paid tribute; yet the top may be set spinning to-day, unhampered by a completed theory to account for its evolutions.

Among recent contributions we may refer in particular to Professor A. G. Greenhill's† noteworthy papers, in which the algebraically accessible or pseudo-elliptic cases, such in which the integrations are possible in terms of circular functions, are worked out in full. Physicists will be grateful to Professor Greenhill for the concrete exhibition given of this complex motion. The

* Lectures delivered on the occasion of the sesquicentennial celebration of Princeton University, by Felix Klein, pp. 1–74, edited by Professor H. B. Fine. New York, Charles Scribner's Sons, 1897.

† Greenhill: Applications Elliptic Functions, Proc. Lond. Math. Soc., 1895, 1896; *Engineering*, July, 1896.

unique method of presentation adopted—all the curves being worked out in form of stereoscopic diagrams—endows his results with an objective reality; and when one remembers that these complex curves reach only especially simple cases of gyroscope motion, one may get some notion of the difficulty of the problem involved.

Turning now, from Greenhill's necessarily cumbersome equations for the approachable part of the problem of rotation, to Klein's little book, one is astonished in finding the most general aspects of the subject treated almost without computation and in so little space. This astonishment, however, is in a manner relieved on learning that the discussion remains formal throughout, that much of it is epitomized, many proofs sketched in, and that the reader is supposed to be thoroughly versed not only in dynamics, but familiarly conversant with the theory of complex variables, with elliptic integrals and functions particularly in reference to their derivation from ϑ and σ-functions, their generalization in terms of automorphic functions, and to be as well read as possible in the geometry of hyperspace. The reviewer, who makes no special pretense to these accomplishments, has taken up Klein's remarkable book, since it professedly appeals to physicists and has groaned through it. He ought, therefore, at the outset to confess to a feeling of hostility because of its unbending mathematical aloofness. In a book with a professed missionary purpose it is not unreasonable to expect just a little condescension in favor of the kind of mathematics with which physicists are, as a rule, more familiar. Judicious annotation either on the part of Professor Klein himself or by Professor Fine would have speeded the propagandist. I doubt whether everybody will 'at once' recognize the elliptic integrals of pages 28, 29 as being normals of the third type, particularly when the notation of Legendre and Jacobi is different. It would have cost but little to give the expanded form of the σ-function. If the reviewer is not incorrect, Weierstrass's original notation was in terms of Abelian functions. The tremendous development of elliptic functions is out of proportion with their application to natural phenomena. Meeting them rarely one forgets them. Memory peters out like the infinite series of a ϑ-function. Mathematicians will do well to observe that a reasonable acquaintance with theoretical physics in its present stage of development, to mention only such broad subjects as electricity, elastics, hydrodynamics, etc., is as much as most of us can keep permanently assimilated. It should also be remembered that the step from the formal elegance of theory to the brute arithmetic of the special case is always humiliating, and that this labor usually falls to the lot of the physicist.

To return from this paroxysm to the splendid research under discussion, let us note first that Klein begins his analysis with the top spinning on a sharp frictionless pivot, so that a simple point in the axis (not the center of mass) is fixed. To this special case the first three lectures are devoted. In the fourth the restriction is cut loose. Klein's method is to consist in a far-sighted choice of coordinates, and the first lecture is, therefore, a comparison of available systems with their mutual transformations. The Cartesian definition of three movable in terms of three fixed coordinates with a common origin in the fixed point, by the 9 direction cosines considered as functions of time, is first taken up. The corresponding transformation scheme is thereafter expressed in terms of Euler's ϑ, φ, ψ, parameters; in terms of the rotational or quaternion parameters, and finally in terms of Klein's new parameters, which are introduced as follows: x, y, z, and X, Y, Z, being the coordinates of given points on a fixed and a movable sphere, re-

spectively, each of radius r and in congruence, the variables ζ and Z defined by the ratios

$$\zeta=\frac{x+iy}{r-z}=\frac{r+z}{x-iy},\quad Z=\frac{X+iY}{r-Z}=\frac{r+Z}{X-iY}$$

will be parameters each of which determines a point on the fixed and movable spheres, respectively. The unique advantage of these non-symmetrical parameters is that when the movable sphere (supposed fixed in the body) rotates, the relation of the parameters ζ and Z is a linear equation of the form

$$\zeta=\frac{\alpha Z+\beta}{\gamma Z+\delta}$$

where α and δ, γ and β are conjugate imaginaries. These quantities connected by the equation $\alpha\delta-\beta\gamma=1$, together with ζ, are used as variables specially adapted for treating the top problem. Hence a scheme of orthogonal substitution and a direct expression of the new parameters in terms of the Eulerian and rotational parameters is fully developed. The lecture closes with an even broader interpretation of ζ for the case when α and γ, β and δ are not conjugate, and time (t) for convenience in the theory of functions is also considered complex.

Starting on more familiar ground, the second lecture begins with a direct attack of the problem of rotation of a body (top) about a point other than its center of mass. Klein uses the expression for kinetic and potential energy in terms of Eulerian speed coordinates, the three corresponding Lagrangian equations of motion and the law of the conservation of energy to reduce the rotation to the following succinct specifications: Let ϑ, φ, ψ be the Eulerian coordinates and put $\cos\vartheta=u$. Let U be a polynomial of the third degree in u, involving besides only integration constants l, n, h, and the (maximum and therefore constant) static moment of the top with respect to the fixed point. Then

$$t=\int\frac{du}{\sqrt{U}},\quad \varphi=\int\frac{n-lu}{1-u^2}\frac{du}{\sqrt{U}},$$

$$\psi=\int\frac{l-nu}{1-u^2}\frac{du}{\sqrt{U}},$$

so that the motion is completely given (Lagrange) in terms of quadratures. Unfortunately, however, these integrals are elliptic and, except in the special cases worked out by Professor Greenhill, do not admit of algebraic treatment, while the 2d and 3d integrals are, beyond this, complex in type. Jacobi, to whom the introduction of elliptic functions is due, was thus able to make an immense stride forward by expressing the Lagrangian integrals u, φ, ψ, and therefore the equivalent cartesian direction cosines, as (one-valued) ϑ-functions of time; but while the direction cosines thus become much simpler time functions than the integrals, they are far more complicated than Klein's parameters α, β, γ, δ. It is the object of the remainder of Klein's brilliant research to show that these quantities are the simplest possible elliptic time functions compatible with the conditions of the problem.

Riemann's conformal representations are naturally selected as the appropriate method of treatment. The first integral (t) is approached by mapping out $\sqrt{U}$ on the plane of complex u. The surface obtained is two-leaved, consisting of two positive and two negative distinct half sheets which cross along segments of the real axis between the 1st and 2d root of cubic U, the 3d root and infinity.

A corresponding conformal representation is now made on the plane of complex time, defined by the first integral above. It is shown that as u moves through the real axis, in the u plane, t for a single half sheet of the $\sqrt{U}$ surface describes a rec-

tangle in the t plane, whose position and sides (periods) are determinate when the time integral is made definite. Four adjacent and congruent rectangles in the t plane correspond to the four half sheets of the Riemann surface. Finally for any march of u around the segments between successive roots of $U_u t$ receives a constant increment, such that the complete image in the t plane covers the whole infinite t surface with congruent adjacent rectangles which nowhere overlap. Hence the important conclusion is accentuated that whereas for each point u there correspond an infinite number of values of time (t), for each value of t there corresponds but one value of u, and hence u like $\sqrt{U}$ are single-valued, doubly-periodic elliptic time functions.

Klein next takes up the relations of φ and ψ to t, a problem much more complex but one in which he scores his most signal triumph. Introducing his own parameters α, β, γ, δ, already defined in terms of Euler's coordinates, Klein obtains normal integrals of the third type without further reduction, while the four logarithmic discontinuities are assignable, one each to $\log \alpha$, $\log \beta$, $\log \gamma$, $\log \delta$, with a common logarithmic discontinuity at $u = \infty$. The transformation thence to exponentials $(\alpha, \beta, \gamma, \delta)$ is equivalent in Klein's interpretation to a passage from elliptic integrals to elliptic functions, and now he is able to avail himself of the quotient of two σ-functions (each of which contains null-points only), together with an exponential time factor to fully express his parameters. They severally vanish for $u = \pm 1$ and became ∞ for $t = 0$, one in each parallelogram of periods. Finally the 9 direction cosines known in terms of α, β, γ, δ are, therefore, also expressed in term of quotients of σ-functions.

Having thoroughly unveiled the character of his parameters α, β, γ, δ, Klein proceeds with their application. The Z pole of the moving sphere is preferably selected for tracing top curves. At this point $Z = \infty$, and, therefore, the paths on the fixed sphere become $\zeta = \alpha/\gamma$. Hence ζ too is at once expressible as a single quotient of single valued σ-functions, together with an exponential time factor. An essential simplification has thus been achieved over all preceding methods. Hermite in his treatment of the stereographic projection of the Z pole needed functions as complex as products of Klein's functions, while even in the hands of Jacobi the first degree of complexity reached only the specialized case of a Poinsot motion, *i. e.*, rotation relative to a fixed center of mass.

A point of cardinal interest in this lecture is the investigation of the rolling and the fixed cones (polhode and herpolode of the top motion), which, by Poinsot's theorem are adapted to describe all rotations about a fixed center. The object in quest here is an expression of the rotation about the instantaneous axis, or preferably of the component rotations about the three movable axes, X, Y, Z, fixedin the body in terms of Klein's parameters α, β, γ, δ; *i. e.*, virtually to refer the rotation to the axes x, y, z, fixed in space. The results again show the remarkable adaptation of the new parameters to the problem in hand. When the three principal moments of inertia are equal, both polhode and herpolode turn out to be elliptic plane curves of the first degree. Thus both polhode and herpolode of the top's motion would be polhodes of two corresponding Poinsot motions; recalling the theorem of Jacobi that the motion of a top may be expressed as the relative divergence of two Poinsot motions.

Finally the motion of the polepoint, already briefly sketched for motion in real time, is resumed, in relation to complex time, to fully bring out the power of the elliptic functions α, β, γ, δ. Attention is first given to the parallelogram of periods in

the t plane, in order to show the limits traced by the pole point on the ζ sphere. Indeed, the investigation is advantageously thrust back a step further by considering ζ as the image of the corresponding four half sheets of the $\sqrt{U}$ surface. It is hardly possible to follow Klein through this involved discussion here without reproducing his figures and computation in full. Suffice it to say that the stereographic projection of the ζ image from the top ($z = r$, $\zeta = \infty$) of the z axis, on the xy plane, is mapped out in correspondence with the parallelogram of periods on the plane of complex time, or for each point of the two positive and negative half sheets of the $\sqrt{U}$ surface.

The lecture concludes with a demonstration showing that a free body in hyperbolic non Euclidian space may be so fashioned as in real time to carry out the actual motions of the top. The form of such a body and the forces which actuate it are specified. Klein lays great stress on the beauty of this generalization.

In the fourth lecture, as already intimated, the top is set spinning on a horizontal plane with its point of support free to roam at pleasure, so that the top now has 5 degrees of freedom. In any case, however, the horizontal motion of the center of mass is uniform, and this point may, therefore, without essential restriction be considered fixed. But if the origin of coordinates be taken at the center of mass the problem returns to 3 degrees of freedom, with the difference that a new term equivalent to its vertical motion must make its appearance in the expression for kinetic energy. Hence a new treatment of the equations of motion is necessary, and if Eulerian coordinates be again introduced the method sketched in the 2d lecture is applicable throughout. The result for t, φ, ψ now, however, lead to hyperelliptic integrals, as for instance,

$$t = \int \frac{\sqrt{(1 + Ps) - Psu^2}}{\sqrt{U}}\, du$$

(where s is the distance between the centers of support and of mass and P the static moment), with a corresponding increase of the difficulty of the problem. The two new roots in the integrand thus make the corresponding Riemann surface two-leaved with six-branch points; but Klein shows that the parameters $\alpha, \beta, \gamma, \delta$ are again singularly adapted for the treatment of the present case, with this fatal difference, that for a single point in the t plane there correspond an infinite number of value of u. Hence as u is no longer a single valued function of t, it becomes necessary to seek a new function of which complex t, α, β, γ, δ shall all be single valued dependents. Such functions are the automorphic functions (η) obtained from elliptic functions by generalizing their periodicity. The line of argument above can now be broadened; construct in the η plane a rectangular hexagon which is the image of a half-sheet of the Riemann surface on the u plane, and which on reproduction covers the plane of complex η conformally and simply. Then to each point on the η plane there corresponds a single point on the Riemann surface; or

$$u, \quad \sqrt{U}, \quad \sqrt{1 + Ps - Psu^2}, \quad \alpha, \beta, \gamma, \delta,$$

are all single valued functions of η. Thus η quite replaces the t in the special case, and Klein carries out his analogies in detail by expressing the automorphic functions in terms of quotients of what he calls prime forms. Hence α, β, γ, δ are now given in terms of quotient of simple prime forms of η-functions, while they were above given as quotients of simple σ-functions. The full geometry of the case is not carried out in these lectures, however, and Klein regrets that the development of the automorphic functions has recently fallen into abeyance.

The reviewer is aware that with all endeavor he has given but an imperfect account of this remarkable book. That Klein's researches constitute a splendid advance in the dynamics of the rotation of a rigid body there can be no question. One cannot but hope that the outline given in these Princeton lectures may soon be expanded and put in shape more easily assimilable by persons moderately versed in the theory of elliptic functions. The boon of an appropriate lemma is ideal generosity, and not even a mathematician can scorn its almost mathematical elegance. A man may be a thoroughgoing soldier enough on land; but put him in the foot ropes of the flying jibboom in a storm, and he is apt to cut a most ludicrous figure. Shift a physicist's foothold of Cartesian differential coefficients, suspend him over an abyss of non-Euclidian space, and he will kick sturdily. Poor policy this, for a missionary!

CARL BARUS.
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*THE TRANSMISSION OF RADIANT HEAT BY GASES AT VARYING PRESSURES.**

BEFORE describing my own investigations on the transmission of heat by gases, I shall refer briefly to the classical work of a somewhat similar nature by MM. Dulong and Petit early in the present century, 'Researches on the Measure of Temperatures, and on the Laws of Communication of Heat,' *Ann. of Phil.*, 1819.

In their researches on the 'Communication of Heat,' Dulong and Petit used as the cooling body a very large thermometer bulb filled with mercury, and as the recipient of the heat a large copper bulb or 'Balloon' about three decimeters in diameter, in the center of which the thermometer bulb was placed. The copper balloon was coated with lamp-black on the inside, and kept at any desired constant temperature by means of a water-bath or melting ice. The thermometer tube was of such length as to bring the zero of the scale outside the balloon; and the thermometer was adapted to be removed, heated and quickly replaced, air-tight. The balloon was connected with an air-pump capable of rapidly exhausting it down to about two millimeters pressure, and also with a gas-holder from which it could be quickly filled with the gas whose cooling properties were to be determined. The rate or 'Velocity' of cooling of the thermometer bulb was deduced from observations of the falling temperature at equal intervals of time.

With this apparatus Dulong and Petit made many carefully conducted experiments at differences of temperature between the thermometer and balloon ranging as high as 300 degrees; and with several different gases besides air, ranging in pressure from atmospheric to two millimeters. From the results of these experiments they deduced several laws of cooling which they held to be general in their application. They sharply divided the cooling into two parts: that due to convection—the actual contact of the surrounding cooler gas renewed by its own currents, and that due purely to radiation—the same as would occur in an 'absolute vacuum.' They derived a constant value for the latter, and values for the former varying with different gases and different pressures. They generally used the thermometer bulb naked, with its natural vitreous surface, but sometimes they silvered it. While this radical change in the character of surface greatly changed the loss of heat due to radiation, it apparently had no effect on that due to convection.

MM. Dulong and Petit fell into the grave error of deducing the behavior of the last

* Abstract of a paper read before the American Association for the Advancement of Science, August 10, 1897.

few millimeters of gas from that of the rest. In this way they arrived at the following 'Sixth Law:'

"The cooling power of a fluid diminishes in a geometrical progression when its tension itself diminishes in a geometrical progression. If the ratio of this second progression is 2, the ratio of the first is 1.366 for air; 1.301 for hydrogen; 1.431 for carbonic acid, and 1.415 for olefiant gas."

My own observations show that this law can be approximately true only in the case of a large balloon, and at pressures from a few millimeters upward. There is no suggestion of it when a small balloon is used, and at small pressures it does not obtain with either large or small balloons.

It was through misplaced confidence in their Sixth Law that Dulong and Petit were led to place a value on the rate or velocity of cooling in vacuo, something like a hundred per cent. too high, and as they derived the cooling values of gases by deducting the cooling effect of a vacuum from the total cooling observed, all their values for gases are much too low.

Other experimentalists, also, have studied the transfer of heat by air and other gases at various pressures. Kundt and Warburg (Pogg. Ann., 1874–5), and Winkelmann (Pogg. Ann., 1875–6), observed that the rate of heat transmission remained substantially constant through a long range of diminishing pressure, and then decreased with further exhaustion. But as they made no measurements of pressure below one millimeter (1316 millionths of atmospheric pressure), their results have no quantitative value for low pressures.

Crookes, in his paper, 'On Heat Conduction in Highly Rarefied Air' (Proc. Roy. Soc., 1880), described a similar experiment in which he carried the pressure measurements as low as 2M. (two millionths). From the fall in the rate of heat loss which occurred between the pressures of 760 millimeters and 1 millimeter, and 5 M. and 2 M., he concludes: "We may legitimately infer that each additional diminution of a millionth would produce a still greater retardation of cooling, so that in such high vacua as exist in planetary space the loss of heat —which in that case would only take place by radiation—would be exceedingly slow."

In this conclusion Mr. Crookes was, I think, wrong. I find that the curve representing the rate of cooling does not break down materially at pressures as low as a twentieth of a millionth.

My own investigations on 'The Transmission of Radiant Heat by Gases at Varying Pressures' form a part of a general study of the properties of high vacua, in which I have long been engaged.

In the course of my work it became necessary to know how much of the heat communicated by a good radiating body at ordinary temperatures, to a neighboring body at a slighly lower temperature, through an intervening gas, is transmitted by the so-called ether, and how much by the gas; and whether any of that transmitted by the gas is communicated otherwise than by the process of convection. Also why, and to what extent, do the gases differ from each other in their heat transmitting capacities.

In the drawings herewith, Fig. 1 is a diagram of the apparatus used in my experiments. A is the thermometer whose cooling was observed. It has a very open scale divided into two-tenths degrees C. The zero point is placed a long distance (about 170 millimeters) above the bulb, for obvious reasons. The bulb is cylindrical, about 20 mm. long, and about 7 mm. in diameter, and is coated with lamp-black applied with a very thin alcoholic solution of shellac. After several hours' baking at 100 degrees in a good vacuum, this bulb gave constant radiation results. The thermometer is suspended by a platinum wire, with its bulb in the center of the large

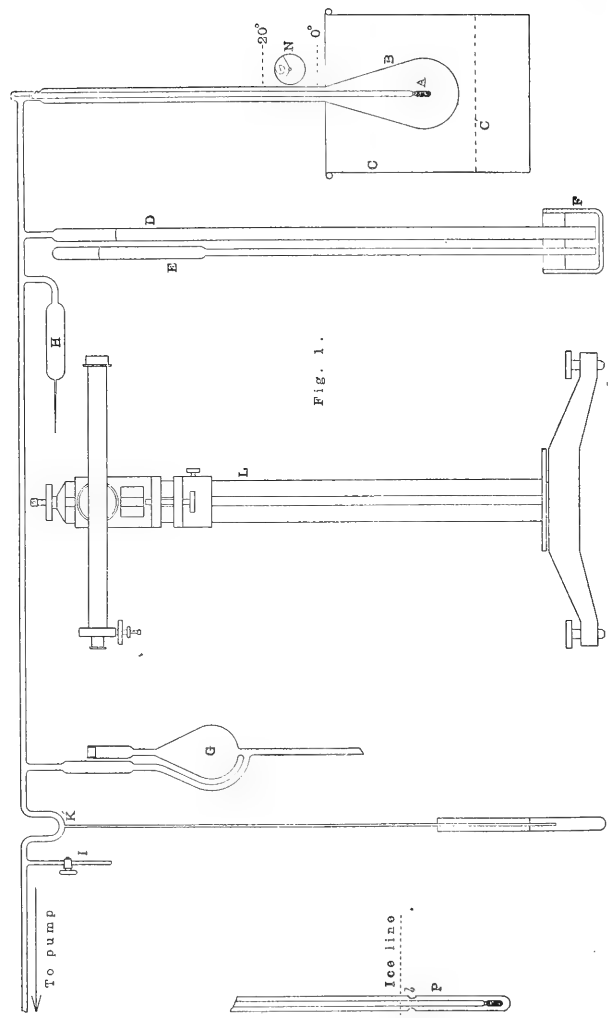


FIG. 1.

pear-shaped glass bulb B, about 112 mm. in diameter. The stem of the thermometer hangs freely in the long neck of the large bulb. I shall hereafter call the glass bulb B the 'large radiation bulb,' or simply the 'large bulb,' to distinguish it from a smaller one used later. The bulb B is surrounded by a copper tank C, lagged with woolen cloth, and filled with crushed ice and distilled water. A wire netting C′ serves to keep some of the ice always below the lowest point of B. The tank C is movable on vertical guides, whereby it may quickly be raised to, or lowered from, the position shown, thus exposing the bulb B alternately to the ice bath and the atmosphere of the laboratory. The bulb B communicates freely with the large barometer tube D, which is used for measuring all but very small pressures. E is a standard boiled barometer, dipping into the mercury cistern F, common to both barometers. G is a McLeod gauge giving very accurate measurements of small pressures, and H is a drying bulb containing phosphorous pentoxide. The glass stopcock I serves to admit other gases than air. The mercury valve K prevents any leakage backward from the pump when the latter is stopped, during observations. Exhaustion is effected by an automatic Sprengel pump having five fall tubes. L is a fine cathetometer placed in front of the whole apparatus, and by rotation on its vertical axis is adapted to read the McLeod gauge, both barometers, and the thermometer. It has a vertically divided scale with veruier and microscope, for reading the barometers, and a micrometer for reading the gauge. A watch N is mounted close beside the thermometer on a sliding frame, so as to be easily kept in the field of view of the cathetometer telescope when the latter is used to observe the falling temperature.

Before using this apparatus, I always exhausted to a good vacuum and heated the bulb B by means of a water-bath, and all other vacuous parts by means of an air bath, to 100 degrees for several hours. This was found necessary in the first instance with air, in order to divest the inner glass surfaces of that portion of their coating of adherent gas most easily given off in a vacuum. This gas was pumped out, and, not being principally air, was not largely reabsorbed when air was admitted. Without this precaution I was unable to obtain constant results at very low pressures. When other gases were tried successively, the preliminary heating prevented gas from one operation attaching itself to the glass and remaining to contaminate the succeeding gas at very low pressures.

I next introduced the proper gas up to atmospheric pressure and made a preliminary cooling of the thermometer by raising the ice tank C. This preliminary cooling was found to have a slight effect on the readings next following, and was done to make the first set of readings on any day entirely comparable with the others. I then lowered the ice tank, and, when the temperature had raised to 18 degrees, stirred the ice and water thoroughly, raised the tank again, and observed the thermometer through the telescope—noting by the watch N the instant when the falling mercury passed each degree of the scale. Then, with the ice tank still up, I noted the pressure by measuring with the cathetometer the difference in height of the barometer columns in D and E. The barometer D showed that the gas in the radiation bulb cooled nearly to zero with very great rapidity when the ice tank was raised. I always measured pressures with the radiation bulb cold. It was usual to repeat the whole operation to confirm results before reducing the pressure by the pump.

Observations were thus made at pressures varying from atmospheric down to the best vacuum obtainable. In some instances

many series of observations were made at varying pressures all within the last millionth. The gauge could be relied upon to measure these small pressures with very great accuracy; but it was difficult to maintain them long at an exactly constant value on account of the continual, though slight, evolution of gas from the glass of the apparatus.

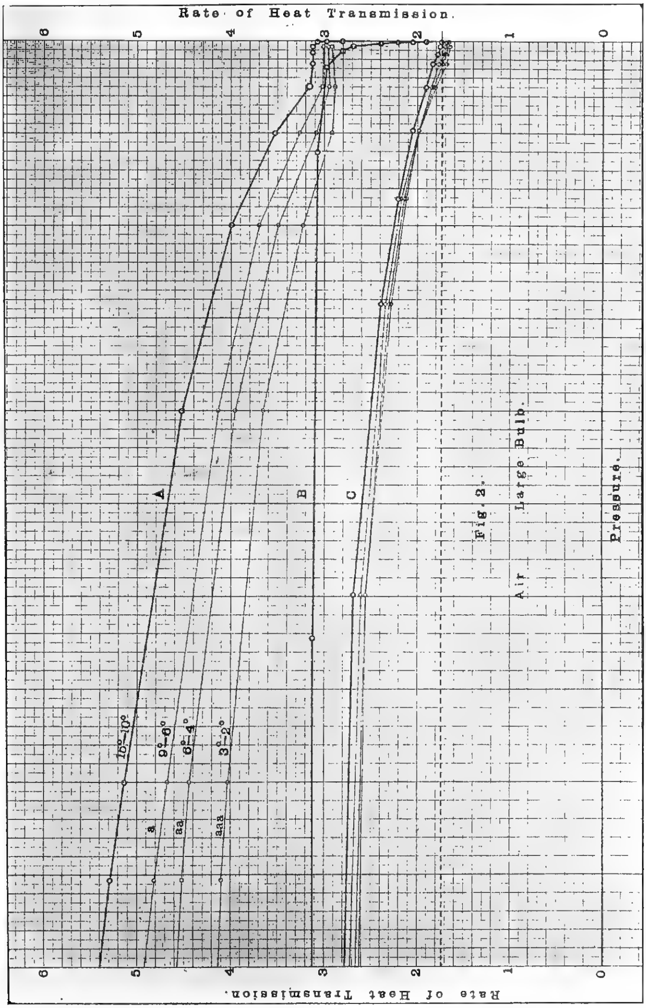
As I desired only comparative results, no correction was made for the probable slight inequalities in the callibration of the thermometer; nor for heat conducted to or from the bulb by the stem; nor for the change of zero point due to changing external pressure. The mercury fell exactly to zero at atmospheric pressure, and about one-fiftieth of a degree lower at no pressure. The pressure error due to differences of capillary depression in the two barometers was ascertained at high exhaustions, and found nearly constant. It was always corrected. The different gases used were carefully prepared and dried, and were introduced quite free from any admixture with air.

My observations have extended over a long period, and are far too voluminous to be recorded here in detail. But I have embodied their most salient features in a series of curves which render them readily apparent to the eye. In these curves the abscissae represent the pressure, and the ordinates represent the rate of heat transmission through the gas, from the thermometer bulb to the ice-cold envelope. The rate of transmission at any particular pressure is expressed by the reciprocal of the number of seconds required for the temperature to fall through a given number of degrees. For convenience of scale, all the reciprocals are multiplied by 500.

Fig. 2 shows the curve for air. The heavy line represents the rate of cooling from 15 degrees to 10 degrees. It is in three sections, A, B and C. Section A embraces the whole range of pressure from nothing to atmospheric; section B embraces the range of pressure from nothing to .01 of atmospheric; and section C embraces the range of pressure from nothing to .0001 of atmospheric, *i. e.*, 100 M. (one hundred millionths). Atmospheric pressure is taken at 760 mm. Thus it will be seen that section B is the last hundredth of A, magnified a hundred times; and section C is the last hundredth of B, magnified a hundred times. This magnification of the abscissae without change of the ordinates, enables us to study every part of the curve with ease. The small circles represent the points in the curve established by observation. These points are shown exactly as found, without any attempt to smooth out rough places in in the curve. The same is true of the curves of other gases. The heavy dotted line parallel with the base indicates that portion of the total heat transmission due to the ether; while all above it represents that due to the air.

Starting at the left-hand end of section A, representing the rate of heat transmission at atmospheric pressure, we observe that the curve drops regularly at a rate faster than the diminution of pressure during ninety-five per cent. of the whole range of pressure from atmospheric to zero. Beyond this point the rate of heat transmission remains substantially constant, as shown by section B and the latter part of A, down to a pressure of about .0003—a range of nearly ninety-nine and a-half per cent. of that remaining. Here the curve suddenly begins to drop again, and falls steadily, as shown by section C and the latter part of B, until it meets the ether line at the zero of pressure.

Under the curve A, I have drawn curves with finer lines, representing the rate of heat transmission at smaller differences of temperature between the thermometer and ice bath. As before stated, A represents the cooling from 15 degrees to 10 degrees.



Rate of Heat Transmission.
6 5 4 3 2 1 0
A
B
C
Fig. 2.
Air Large Bulb.
Pressure.
10°–10°
9°–6°
6°–4°
3°–2°
a
aa
aaa
Rate of Heat Transmission.

FIG. 2.

On the same scale a represents the cooling from 9 degrees to 6 degrees; aa from 6 degrees to 4 degrees, and aaa from 3 degrees to 2 degrees. Now, Newton's law of cooling requires that the rate shall vary directly with the difference of temperature between the cooling body and the surrounding medium. While this law is known to be incorrect for large differences of temperature, it is generally accepted for very small differences. If it were correct under the conditions of the present experiment, then the ratios of the times required for the temperature to fall through the several ranges above indicated would all equal unity, and the curves A, a, aa, aaa would coalesce. But they are very far from doing this. It will be observed that all of these curves preserve their relative values very closely indeed, until they approach the point of pressure where the curve A reverses itself; then they begin to bunch themselves very much closer together, especially the lower ones, and shortly reach a greatly reduced as well as varied ratio of values which they retain substantially unchanged to the end, as shown in connection with section C. To avoid confusion of lines, I have omitted the secondary curves corresponding with section B.

Carbon monoxide was chosen for comparison with air, because its absorptive power for radiant heat is many times greater, while its specific heat is almost exactly the same. The principal curve, representing the rate of heat transmission from 15 degrees to 10 degrees, differs very little from that of air. It shows a slightly better rate than air at very small pressures; not quite so good a rate as air at intermediate pressures; and the same rate at atmospheric pressure. But the curves a, aa, aaa, representing equivalent amounts of cooling at smaller temperature differences, are materially unlike those of air. At high pressures they have about the same ratio values as with air; but the ratio diminishes much less at intermediate and low pressures; that is to say, the curves remain further apart. It is equally noticeable that the curves aa, aaa retain their full relative ratio values at low pressures, while with air they nearly coalesce.

It was thought that ethylene might transmit heat more rapidly than air, because of its much higher specific heat. But it does not do so. Its curve has the same form as those of air and carbon monoxide. It transmits heat nearly as well as air at atmospheric pressure, but not nearly so well at intermediate pressures. At a very few millionths, however, it conducts a trifle better than air. The curves a, aa and aaa have the same characteristics and about the same ratios as those of carbon monoxide.

Hydrogen was next tried, on account of its very low coefficient of viscosity, as well as its very high specific heat. While in general form the hydrogen curve resembles the air curve, all the ordinates are immensely increased. It is noticeable that the intermediate section B of the curve lies much nearer A than C, quite different from its relative position in the curves of the other gases. This section of the curve shows that hydrogen retains about two-thirds of its initial heat transmitting power at a pressure nearly two hundred times smaller than does air. The curves A, a, aa and aaa have something like the same ratios as they have in the cases of carbon monoxide and ethylene. In general, it may be said of hydrogen in the large radiation bulb, that it transmits heat nearly four times as fast as air at atmospheric pressure; more than twice as fast at a very few millionths, and more than seven times as fast through a long range of intermediate pressures.

As evidence of the accuracy of the observations on which the curves thus far described are based, it is gratifying to note

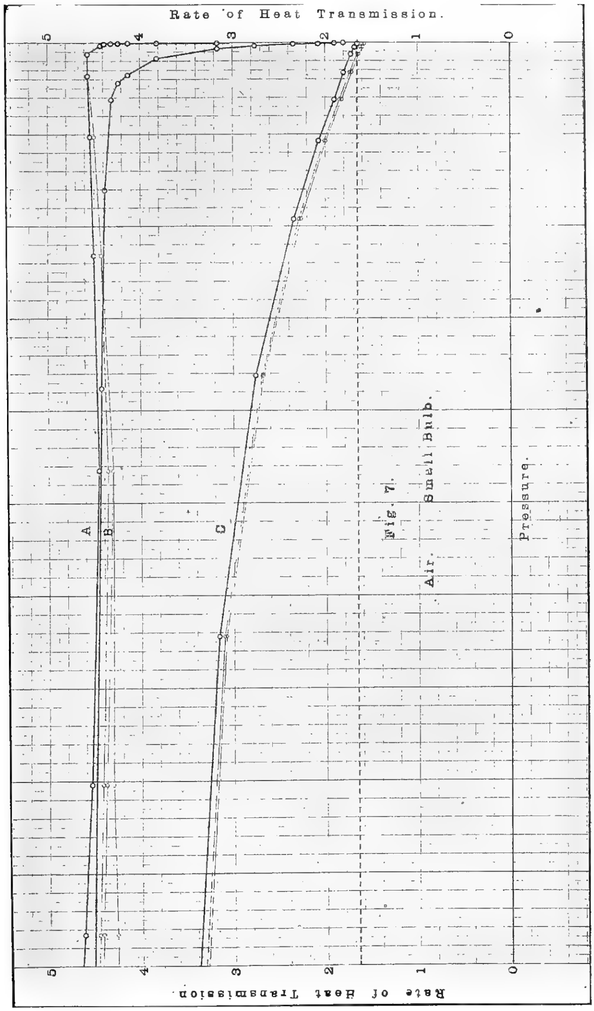

Rate of Heat Transmission.
5 4 3 2 1 0
A
B
C
Fig. 7.
Air. Small Bulb.
Pressure.

FIG. 3.

that the vacuum, or ether line, locates itself exactly the same in all.

In making the above described observations, I looked for some change in the phenomena when the exhaustion reached the point at which the mean free path of the gas molecules equalled the distance between the thermometer bulb and the cold walls of the enclosing globe. This should have been at a pressure of about two millionths. No such change was observable, however, in any case. Partly in pursuance of the same idea, I resolved to repeat some of my experiments, using a very much smaller radiation bulb. This I expected would also reduce that portion of the total cooling effect due to convection currents. I accordingly employed the bulb of tube P, Fig. 1, in my further experiments. This is made from a thin glass tube slightly less than 20 millimeters internal diameter, and in it hangs the same thermometer A which was used before. In transferring the thermometer great care was taken to avoid any disturbance of the coating of lampblack on its bulb. At b is a contraction of the tube P, to prevent the thermometer bulb swinging against the inside of the tube. The contraction b is, however, much larger than the thermometer stem, so that normally the latter does not touch it. The thermometer bulb hangs exactly in the center of P, near its bottom, and is separated from it by a space of a trifle more than six millimeters—almost exactly a quarter of an inch—instead of two inches, as in the case of the 'Large bulb.' The tube or bulb P, I shall hereafter designate the 'Small radiation bulb,' or simply 'Small bulb,' to distinguish it from the large one.

The curve for hydrogen, with the small bulb, differs radically in size and form from that obtained with the large bulb. Section A, instead of drooping rapidly with decreasing pressure, maintains almost full value throughout. Section B starts with nearly double its old value, but breaks down much earlier. Section C starts with a little higher value, but is much straighter, and consequently has a lower value throughout most of its length. The curves a, aa, aaa are very peculiar. They start at atmospheric pressure with much smaller total and very different relative ratios than before, and are successfully absorbed into A. They reappear later, however, but with small ratios.

Fig. 3 gives the curve for air, with the small bulb. It differs from that with the large bulb quite as much as did the hydrogen curve. Section A droops slightly, and regains almost its full atmospheric value at one per cent. pressure. Section B has the same form as with the large bulb (Fig. 2), but more than double its value; and section C also has a much higher value throughout. The curves a, aa, aaa have small ratio values at the beginning, and are absorbed into section A, the same as with hydrogen. But aa and aaa coalesce when they reappear, and coincide to the end; while the ratio between a and aa remains constant at a very small value.

The curve for carbon dioxide, with the small bulb, closely resembles the air curve in form, but has a very much smaller value throughout. While the curves aa and aaa are soon united, and remain so to the end, a and aa never disappear as they did in the cases of hydrogen and air.

With the small bulb, as with the large, no change in the character of the phenomena was observable when the exhaustion had reached the point at which the mean free path of the molecules equaled the space through which the heat was conducted. This point was reached in the small bulb at a pressure of about fourteen millionths.

It seems reasonable to assume that the radical difference between sections A of the curves obtained with the large and small bulbs respectively was due to an almost complete suppression of convection currents

in the latter case. In the absence of convection currents that part of the heat transmitted by the gas was probably carried by a process analogous to conduction in solids. The shortness of conductor in the case of the small bulb may account for the greatly increased rate of conduction. But why the conductivity of a gas remains nearly constant through a very wide range of pressures is not clear. Mr. Crookes' explanation of this phenomenon seems to me very unsatisfactory.

It will be noticed that the 'Ether line' is about four per cent. lower with the small bulb than with the large one. This may be due to the greatly decreased amount of surface presented by the small bulb for absorption of the radiant heat.

The enormous heat-conducting capacity of gases at very small pressures is strikingly shown in all the curves. But hydrogen is preeminent in this respect. Thus, in the large bulb, hydrogen at a pressure of only twenty-six millionths of an atmosphere transmits heat as rapidly as the ether. At seventy-six millionths it equals air at atmospheric pressure; that is to say, it does the work of nearly two hundred thousand times its weight of air.

It is remarkable that at pressures up to a few millionths, all the curves are nearly straight lines. This is especially noticeable in the small bulb curves; showing that at these small pressures the heat-transmitting power of a gas varies directly with its amount. Hence it seems reasonably certain that if the very small fraction of a millionth of the gas examined, which remained at the end of each experiment, could have been entirely removed, the heat transmitting power of the vacuum would not have been materially diminished. It was customary at the end of the experiments with each gas to close the gauge permanently when the pressure had fallen to a tenth of a millionth or so; and with the capacity of the whole apparatus thus reduced, run the pump continuously from one to two hours. Several sets of observations were always made during this extreme exhaustion; and while the change in the rate of cooling of the thermometer was generally appreciable, it was always very small indeed. In my earlier experiments I took the greatest care to insure the absence of mercury vapor in the final vacuum. But the presence or absence of mercury vapor made no difference distinguishable from the errors of observation.

Of course, the best vacuum producible by a Sprengel pump still contains many thousands of millions of gas molecules per cubic centimeter. This may be regarded as a prodigiously large or exceedingly small quantity of gas, according to our point of view. While it has no apparent effect on the general heat-transmitting capacity of the vacuum, it does seem to interfere with or modify some function of the ether. This is the only explanation of certain phenomena that I can offer. I refer to the different behavior of the vacua with different residual gases, and in different sized bulbs, in the matter of adherence to, or departure from, Newton's simple law of cooling. The curves a, aa, aaa illustrate these differences in the several cases at the extreme end of section C of the principal curves. These differences are too large to be attributed to errors of observation. This is one of several reasons which lead me to suspect that at higher pressures all the gases examined interfere materially with and retard the transmission of heat by the ether. In other words, I suspect that the dotted ether line of my curve sheets should not be drawn parallel with the base, and have a constant value at all gaseous pressures, as shown, but should have a decreasing value as the gas pressure rises from zero. On this interesting phase of my subject I hope to have more to say at a future date.

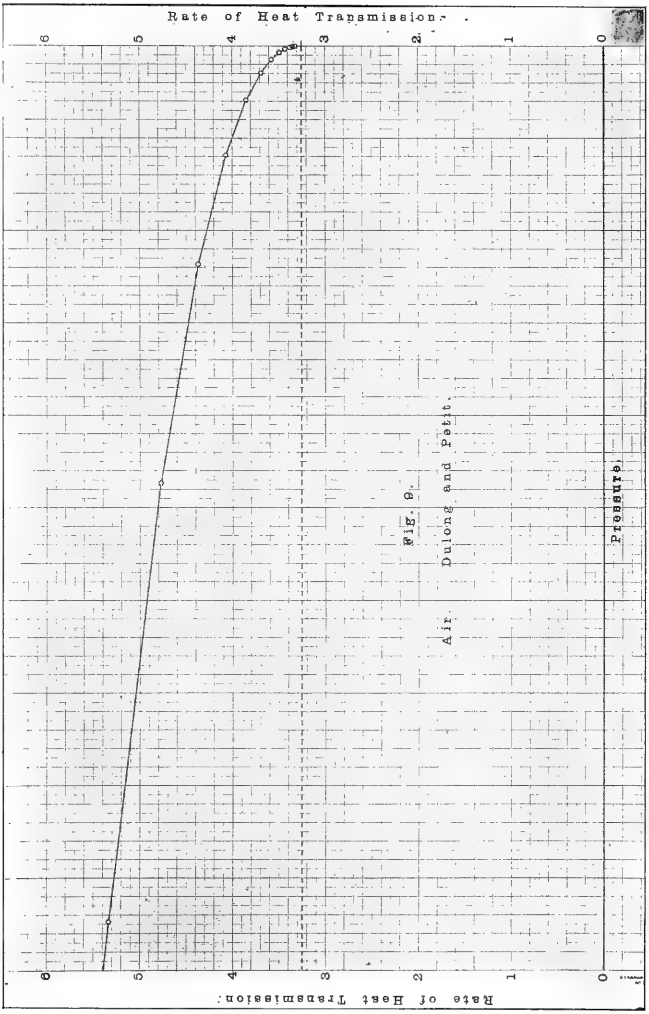

Rate of Heat Transmission.
6 5 4 3 2 1 0
Fig. 9.
Air. Dulong and Petit.
Pressure.
6 5 4 3 2 1 0
Rate of Heat Transmission.

Fig. 4.

Fig. 4 is an air curve plotted from figures given in Dulong and Petit's paper. It is drawn to such a scale that the rate of heat conduction at atmospheric pressure is the same as in my own experiment with air in the large bulb, and illustrated in Fig. 2. The first five stations in the curve are the ones from which they deduced their 'Sixth Law' of cooling. The rest of the curve is drawn in accordance with that law, and the vacuum line represents exactly the value they assigned to the cooling power of an absolute vacuum. Comparison with Fig. 2 shows how much they erred in their deductions.

A study of the curve embodying the results obtained with a mixture of three volumes of hydrogen, and five volumes of carbon dioxide in a small bulb, shows that the carbon dioxide interfered very greatly with the performance of the hydrogen. Before any exhaustion was made, the hydrogen *alone* would have done more than three times the work of both gases. It was not until the pressure had fallen to about one hundred millionths that both gases combined, did as well as the hydrogen would have done alone. Below this pressure both gases contributed to the result.

This interference of mixed gases is a very interesting phenomenon, and seems to warrant the careful investigation which it is my intention to give it.

CHARLES F. BRUSH.

CLEVELAND, O.

THE BREEDING OF ANIMALS AT WOODS HOLL DURING THE MONTH OF MARCH, 1898.

THROUGH the courtesy of the United States Commissioner of Fish and Fisheries, several naturalists have been enabled to make use of the equipment of the Biological Station at Woods Holl during the past month, and the following notes may be of interest to those who contemplate pursuing lines of investigation at either of the marine laboratories:

The water has swarmed with animal life, and many forms rarely or never captured during the warmer months have been found in abundance. Breeding animals have yielded rare embryological material, and all forms of life have had great vitality, due probably to the low temperature of the water. The temperature of the water has ranged from 38 F. at the beginning of the month to 43 F. on the 30th. Its specific gravity has varied from 1.0232 to 1.0236.

Among vertebrates the winter flatfish (*P. americanus*) has been taken in large numbers, and spawning individuals have yielded an abundance of embryos and young. The clustered eggs of the small sculpin (*Acanthocottus æneus*) have been taken from nets and from sea-weed, and the young have been conspicuous in the *Auftrieb.* The surface towings have also yielded young of the common cod (*G. callarias*), eggs of which were hatched at the Station during the earlier portions of the month. Young cod, from one-half to three-fourths of an inch in length, have been found feeding exclusively upon Copepods, and associated with them were the somewhat larger pollock (*Pollachius virens*). The Gadidæ have also been represented by numerous adult 'frostfish' (*Microgadus tomcod*), though the breeding period of this species is in December. The young of the sand-launce (*Ammodytes americanus*), from one-half to one inch in length, and of the eel (*A. chrysypa*), from two to two and one-half inches in length, have also been taken. The pipe-fish (*Siphostoma fuscum*) was not examined, though it was found in Narragansett Bay with eggs and with young March 22, 1897.

The 'alewife' or spring herring (*Pomolobus pseudoharengus*) has begun to enter the fresh-water streams from the sea, though it has not yet begun to deposit its eggs.

Several Crustacea are already breeding. The green crab (*Carcinus granulatus*) is car-

rying about its orange-colored clusters, and Mysis has its brood-pouches distended with embryos. Several species of Amphipods bear eggs. One of these is a large light-colored species, apparently in the height of its breeding season; thousands have been captured in small traps baited with fish. Associated with this amphipod and captured in the same manner, though not breeding, were numerous examples of the Isopod, *Cirolana concharum.* Enormous, bright-colored Caprellas were dredged in the 'Sound,' and many eggs were taken. *Crangon vulgaris* is breeding, of course, and it would be interesting to learn when this species is not pregnant. *Palæmonetes vulgaris, Virbius zostericola* and *Hippolyte pusiola* have been frequently taken, the latter with eggs. The Eupagurids (*E. Bernhardus, E. longicarpus, E. policaris* and *E. annulipes*), though showing enlarged ovaries through their transparent body-walls, have not extruded their eggs. The same may be said of *Gebia affinis* and *Callianassa stimpsoni*, many individuals of which were taken in Narragansett Bay on March 8th, of the present year.

Limulus has not yet approached the shore, though a single specimen was taken in a fyke-net at Waquoit on March 25th. No Cirriped larvæ have been taken. On January 3, 16 and 22, 1896, great numbers of these nauplii were taken at Bristol Narrows, R. I., and on February 14th they were still common, though not so abundant. Of course, Copepods have formed a large proportion of the organisms taken at the surface, and they appear to be even more abundant than during the summer months. Volumetric data respecting the Plankton are much desired, though the efficiency of the ordinary methods for securing Plankton will be materially affected by the annoying presence of a gelatinous alga, which quickly renders the net all but useless.

Vermes.—Having seen myriads of *Nereis virens* swimming in the shallow water of the shores of Narragansett Bay, and having collected several hundred specimens on March 23, 1897, when the water was actually colored with the extruded eggs and spermatozoa, we were not surprised to find several individuals swimming about at Woods Holl. The eggs of this species have not been carefully studied, though they offer some interesting features to those at work upon cell-lineage. Specimens of immature eggs were taken on January 29, 1896, and at Bristol Narrows on March 26th of the same year there were scores of 'spent' males. The height of the breeding season, then, is probably during the earlier and middle portions of the month of March. Annelid larvæ of other species have been abundantly taken both in January and in February.

Heteronereis limbata was found at Woods Holl, swimming about on the surface, in broad daylight. The males, on examination, proved ripe. *Autolytus cornutus* was frequently taken with eggs, and *Harmothœ* and *Lepidonotus* appeared to be almost ripe. *Chœtopterus, Rhynchobolus, Maldane, Sthenelais, Trophonia, Clymenella,* and *Phascolosoma* were collected, but not in sufficient numbers to definitely determine their sexual condition. *Sagitta* was excessively abundant, and the large clear eggs could easily be seen through the transparent integument.

Mollusca. — Cephalopod mollusks have not arrived, and time has not permitted the examination of the Lamellibranchs. The egg-capsules of the smaller Gastropods, so abundant later in the season, were conspicuous by their absence. Naked mollusks of gorgeous coloring were dredged in the 'hole' and 'sound.' *Doto coronata, Eolis bostoniensis* and *Alderia harvardiensis* were the most abundant species; the two latter are breeding in the laboratory.

Echinoderms.—There is every indication that April will be an excellent time for one who wishes to secure an abundance of Echinoderm material, either for embryological or for experimental study. The star-fish are approaching sexual maturity. The most attractive eggs are those of the 'sand-dollars' (*Echinarachnius parma*). Bushels of this echinoid were dredged off Quick's Hole. The eggs readily fertilize and develop normally. The first cleavage occurred two hours after fertilization; the gastrulation occurred in from 30 to 36 hours. 'Plutei' from embryos hatched on March 22d were raised without difficulty, and are now, at the end of the month, still living. I regret that observations on the breeding habits of the Holothurians were not made.

Cœlenterates.—The wealth of Cœlentarete life found during this month is bewildering and distracting. Ctenopores (adult *Mnemiopsis* and *Pleurobrachia*) hydro- and scyphomedusæ abound. The *Ephyra* and young of *Aurelia* were taken at Waquoit in countless numbers and lived in the laboratory from the 16th to the close of the month. On March 30th the calm surface of the water in Great Harbor was literally spangled with the slightly protruding discs of *Cyanea*. The piles and rock-work of the 'basin' are covered with breeding 'Hydroids' of *Coryne*, *Clava* and *Parypha*. The dredge has brought up *Sertularia argentea*, laden with eggs, and, most beautiful of all, enormous specimens of *Tubularia couthouyi*. The expended hydranths of this species are as large as 'bachelor's buttons,' and are borne upon a stalk several inches in height. They literally droop with their burden of ripe gonophores. The young are possessed of remarkable vitality and would make excellent material for experimental work. *Tima formosa*, though abundant in Narragansett Bay from January to March in 1896, has not thus far been seen either in the 'Sound' or in Buzzards Bay. *Metridium*, *Sagartia*, *Halcampa* and *Astrangia* have been taken, though an examination of their reproductive glands has not been made. *Grantia* is not abundant, and the individuals collected were small and apparently immature.

H. C. BUMPUS.

THE ANNIVERSARY MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE local committees for the Boston meeting—the fiftieth anniversary to be celebrated from August 22d to 27th—have now been arranged, and contain the names of a greater number of men of science and men interested in science than could probably be secured in any other city of the United States, not excepting New York and Washington. His Excellency, Roger Wolcott, Governor of Massachusetts, is Honorary President of the Committee; Colonel Henry L. Higgenson is the Honorary Treasurer and Professor Thomas Dwight, Professor Alpheus Hyatt and Professor E. C. Pickering are the Honorary Secretaries. The chairman of the reception committee is Dr. J. R. Chadwick; of the committee on rooms for meetings, Professor Charles R. Cross; of the committee on invitations for foreign guests, Professor H. P. Bowditch; of the committee on excursions, General Francis H. Appleton; of the Cambridge committee, President Chas. W. Eliot; of the Salem commitee, Hon. Robert S. Rantoul, and of the executive committee, Professor William T. Sedgwick. The Local Secretary is Professor H. W. Tyler, Massachusetts Institute of Technology.

Professor F. W. Putnam, President and until the meeting Permanent Secretary, has prepared the following letter calling attention to the meeting: Early in the year 1897 the Boston Society of Natural History appointed a committee to take the initiative in extending an invitation to the Associ-

ation to hold its Jubilee Meeting in Boston. Later, the Governor of Massachusetts and the Mayor of the city of Boston united with the various scientific and educational institutions of Boston and vicinity in a cordial invitation to the Association to hold its anniversary meeting in the city of its birth. This invitation was accepted at the Detroit meeting.

The Boston Local Committee is now organized; and the names of the distinguished men and women included in this Committee is a guarantee that everything will be done to make the meeting a successful one, both in its scientific and its social aspects. All realize that this anniversary gives promise of being the most important scientific gathering ever held in the United States, and that the celebration of fifty years of science in America is an occasion worthy of the best efforts of the city.

Many foreign scientists will be invited to take part, and many foreign educational and scientific institutions will undoubtedly send delegates, thus giving to the meeting an international character.

During the Association week and the days immediately preceding, a number of affiliated societies will meet in Boston, including the American Forestry Association, the American Geological Society, the American Chemical Society, the Society of Economic Entomologists, the Society for Promoting Engineering Education, the Society for the Promotion of Agricultural Science, the American Mathematical Society and several other important bodies.

The officers of the Massachusetts Institute of Technology and of the Boston Society of Natural History have generously placed their halls and rooms at the disposal of the Association; and thus accommodations will be furnished for all the Sections and for the General Sessions in three closely adjoining buildings.

The Corporation of Harvard University has invited the Association to be its guest for a day in Cambridge, and the Essex Institute has arranged for a day in Salem. There will also be an excursion in the harbor and, after the meeting, trips to the White Mountains and to Cape Cod. Members who were present at the last Boston meeting, in 1880, and at the Salem Meeting, in 1869, will recall many pleasant memories of those occasions, when the importance of the scientific gatherings was rivalled only by the enjoyment of the social entertainments.

Believing that every member of the Association will wish to attend its fiftieth anniversary, all those whose names have dropped from the roll are earnestly requested to renew their membership, either by paying back assessments and having their names replaced on the role under their old date of election or by re-election.

It is my hope that at least a thousand new members will be elected by the Council before the Boston meeting, and I beg of each member of the Association to aid me in accomplishing this, my last request as Permanent Secretary. There are in every community many men and women engaged in scientific work who should be invited to join the Association; and there are many more qualified to become members who would find in the meetings of the Association the very incentive they need to develop their love of scientific work. I earnestly appeal to every member to make known the objects and character of the Association, and to aid in securing such an increase of membership as shall make this fiftieth anniversary a marked event in the history of the Association.

Nominees for membership will be considered at the Council meetings to be held before the Boston meeting. All nominations should be sent to the Permanent Secretary that they may be considered at the first following meeting of the Council.

A fiftieth anniversary card will be sent to each member entitled to it. A list of all paying in advance will be printed for the opening day of the Boston meeting. This list will indicate whether a member is to be present or absent. Such a list will greatly facilitate the arrangements for the meeting, and all members are requested to give this new feature their earliest attention. Associate members (wives and daughters, and sons under twenty-one years of age) will also be provided with the anniversary cards, and will have their names entered on the list upon receipt of the associate fee of three dollars.

It is hoped that one of the results of this anniversary meeting will be an increase of the research fund of the Association. To this end members are reminded that they can commute their assessments for life by the remittance of fifty dollars. All money thus received is invested and the income is used for the encouragement of research. This fund now amounts to about $6,000, which has accumulated during the past twenty years.

The Sectional Committees of each Section will prepare programs for the Sections in advance of the meeting, and notice of papers offered should be sent to the respective Secretaries at an early date.

It is hoped that all the surviving founders of the Association will be present at the Boston meeting, and I shall be much indebted to anyone who will send me the full name and address of any survivor of the meeting of 1848.

It is now twenty-five years that I have had the pleasure of serving the Association as its Permanent Secretary. During all this time I have held the firm belief that the mental stimulus and broadening influence, afforded by such annual gatherings of persons interested in the various departments of science are of vital importance to every professional scientist. Such reunions not only promote good fellowship among scientists and lovers of science, but also serve to prevent the specialist from becoming so exclusively absorbed in his own particular life work as to forget that it is his duty to unite with his fellow workers in securing results which make a scientific career worthy of special respect—the advancement and diffusion of knowledge and the amelioration of mankind.

CURRENT NOTES ON PHYSIOGRAPHY.

WATERFALL LAKES IN CENTRAL NEW YORK.

IN continuation of the brief suggestion by Gilbert a year ago, Professor E. C. Quereau, of Syracuse, describes the 'Topography and History of Jamesville Lake' (Bull.Geol.Soc. Amer., IX., 1898, 173–182), which furnishes another illustration of exceptional forms in a dissected plateau, thus appropriately following the example of isolated hill groups in the dissected uplands of Missouri, as described by Marbut (SCIENCE, VII., 273). Jamesville lake, a few miles southeast of Syracuse, occupies a cavity in a north-sloping arm of the Allegheny plateau, which is here normally divided into digitate spurs by many obsequent streams and their insequent branches. The lake and the gorge by which it is drained eastward into Butternut creek (obsequent) are the work of a temporary glacial river, which ran eastward between the northward land slope and the southward slope of the retreating ice sheet. A large current of water thus guided crossed several of the plateau spurs, carving channels of greater or less depth, and in a number of cases forming waterfalls on the sill of the Corniferous limestone; the falls retreating and pools being formed beneath their plunge in a fashion normal enough to the glacial river, but entirely abnormal to the ordinary drainage of the plateau. Jamesville lake is one of these

pools. It is about 500 feet in diameter and 60 feet deep, its surface lying 160 feet beneath the adjacent upland. Steep cliffs rise on three sides, while the gorge opens eastward to Butternut valley. All the features of a dry Niagara are here disclosed in great detail. Several excellent illustrations accompany the paper.

ESKERS IN IRELAND.

'A map to show the distribution of eskers in Ireland,' by W. J. Sollas (Sci. Trans. Roy. Dublin Soc., V., 1896, 785–822, maps), is a serviceable summary, based chiefly on the work of the official Geological Survey, with personal observations in certain districts. Although predisposed in favor of the marine origin of askers, the author concludes that nothing is so competent to explain their various features as the action of streams in subglacial tunnels. Their height is 50–60 feet; their elevation above sea-level seldom reaches 400 feet. The convergence of branch eskers towards a trunk is properly regarded as one of the most indisputable signs of stream origin. Three notably fine esker systems deserve mention; the Midlands system, on the central plain, half way from Dublin to the west coast, where three distinct and many subordinate eskers converge eastward; the Ballyhaunis system, with three distinct branches converging northward against the general slope of the country between the headwaters of the south-flowing rivers Suck and Clare; and the Portumna system, having three branches converging eastward with the general slope of the country from Slieve Aughty into the valley of the Shannon above Lough Derg, but crossing the subordinate valley of the Ardultagh on the way. One member of the Midlands system near Athlone is illustrated by a special map, showing it to be of exceptional irregularity of form, a confused network of ridges with disordered structure, instead of a long narrow ridge; here, if anywhere, an origin in a super- or englacial stream might be inferred. A useful summary of previous writings is included in the essay.

DESERT CONDITIONS IN BRITAIN.

The interpretation of the past through the present is a canon of orthodox geology. Under its guidance, the existing oceans and rivers have been carefully studied; but the deserts of to-day have until recently received little consideration as the representatives of ancient conditions. An opportune article on 'Desert Conditions in Britain,' by J. G. Goodchild, (Trans. Edinburgh Geol. Soc., VII., 1899, 203–222), calls attention, first, to the characteristic features of existing deserts, by which their former occurrence may be recognized; second, to the probability that the British Isles have more than once had a desert climate in the remote past. Various details are given concerning the composition and structure of the deposits of deserts. For example, comparison of desert and seashore sands shows that any sandstone largely composed of well-rounded grains was probably formed under arid conditions on a land surface. The British deposits of Triassic, Devonian and Torridonian times are thought to have been formed under inland, desert, continental conditions.

The change thus implied in continental outlines needs consideration along with the arguments commonly quoted in support of the permanence of continents. Great Britain must have had much land or a high mountain range to the windward when the desert sandstones and saline deposits of Cheshire resembled the 'salinas' of modern deserts. Otherwise the earth's axis must have shifted; for the low western border of a continent in mid-temperate latitudes is the last place in the world where salinas and desert sandstones can form.

THE NEW ZEALAND VOLCANIC ZONE.

H. M. CADELL describes a visit to the New Zealand Volcanic Zone (Trans. Edinburgh Geol. Soc., VII., 1897, 183–200), with particular references to the changes caused by the eruption of 1886, when the famous Rotomahana terraces were destroyed. A peculiar result followed the shower of fine ashes which coated the region for miles around, and which, when wet with rain, formed an impervious, clay-like cloak. Before the eruption the region was covered with vegetation, and rainfall was slowly discharged. After the ash-cloak was laid on, the surface became water-tight, 'like the slated roof of a house,' and shed the rainfall in streams which united in fierce torrents and excavated deep gorges in the valley floors. Two new lakes, replacing Rotomahana, had a joint area of 25 acres in 1886, shortly after the eruption; in 1893 the water had risen over 400 feet, the two lakes had united, and their area exceeded 5,600 acres. A further rise of about 100 feet will be needed for overflow. The great fissure along which numerous explosive craters were formed in 1886 is briefly described.

W. M. DAVIS.

CURRENT NOTES ON ANTHROPOLOGY.

ONTARIO ARCHÆOLOGICAL REPORT.

MR. DAVID BOYLE's annual archæological report to the Minister of Education, Ontario, is, as usual, rich with descriptions of interesting additions to the museum, and information attractive to students of local antiquities (pp. 87, Toronto, 1898, Pub. Doc.). All the material was removed and rearranged during the year, and it is now installed to much better advantage. The report is illustrated with over fifty figures in the text, representing stone and metal remains, village sites, textile work, engraved shells, bone implements, etc. Some ancient maps are reproduced from early explorers, and Mr. A. F. Hunter adds a useful bibliography of the archæology of Ontario.

THE PUEBLO OF TAOS.

IN the form of an inaugural dissertation, Mr. Merton Leland Miller has issued from the press of the University of Chicago a pleasant description of the Pueblo of Taos, New Mexico. In 1896 he passed three months in this ancient settlement of the Tiguas Indians, and noted the peculiarities of their lives and environment. These he sets forth in a clear style, and discusses the questions of origin and affinities from the view-point of the practical observer. He is inclined to adopt the conclusion that these and most of the pueblo-dwellers are a mixed population, the Shoshonean blood predominating.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY

IN the last *Proceedings* of the Chemical Society (London) a new method of making hydrocyanic acid is described by John Wade and L. C. Panting. A cold mixture of equal volumes of concentrated sulfuric acid and water is allowed to drop on 98% 'lump' potassium cyanid. The prussic acid evolved is almost theoretical in amount, and is nearly anhydrous, and may be readily collected in quantity by suitable condensing apparatus. This method offers great advantages over that usually employed. When, in the place of a diluted acid, concentrated sulfuric acid is allowed to drop in the potassium cyanid, nearly pure carbon monoxid is evolved, and this also in nearly theoretical quantities, traces only of hydrocyanic acid being present. In this reaction the sulfuric acid plays at the same time the part of both hydrolysing and dehydrating agent.

THE same *Proceedings* contains a paper by W. C. Reynolds on concentrated solu-

tions of potassium carbonate. In such solutions the salt seems to act as a potassium salt of the radial KCO_3 and forms with salts of certain metals double carbonates. When, for example, salts of copper, manganese, calcium, cobalt, etc., are added to a concentrated solution of potassium carbonate, double carbonates are formed, which crystallize out on standing, but which are decomposed on diluting the solutions. The formulæ of these salts are $CuK_2(CO_3)_2$, $MnK_2(CO_3)_2$, $CaK_2(CO_3)_2$, $CoK_2(CO_3)_2$, etc., which might be looked upon as $Cu(KCO_3)_2$, etc.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE National Academy of Sciences will hold its annual stated session at Washington on April 19th, 20th and 21st.

THE third regular meeting of the Chicago Section of the American Mathematical Society will be held at the University of Chicago, on Saturday, April 9, 1898, the first session opening at 10 o'clock a. m., in Ryerson Physical Laboratory.

THE bequests made by the late Professor Cope to the University of Pennsylvania are now being placed in the Library and in the Biological Hall. The bequests, as we have already stated, fall under five heads: First, the scientific library; second, the Wheatley collection of fresh water mollusca; third, the Wheatley collection of minerals; fourth, the Hyrtl collection of the osteology of fishes; fifth, Professor Cope's collection of the osteology of vertebrates. The scientific library contains many valuable sets of scientific journals, monographs and books of reference. Professor Cope purchased the Hyrtl collection of the osteology of fishes for $8,000, and the osteological collections made by Professor Cope himself are of great value.

THE French Minister of Commerce has issued a decree instituting twelve congresses to be held during the Paris Exposition of 1900 as follows: 1. Education; 2. Fine Arts; 3. Mathematical Sciences; 4. Physical Sciences and their Applications; 5. Natural Sciences; 6. Medical Sciences; 7. Engineering and Transportation; 8. Agriculture; 9. Political Economy and Statistics; 10. Social Sciences, including Hygiene; 11. Geography, and 12. Industry and Commerce. The Minister of Commerce will appoint twelve committees who will report to a commission that will have charge of the arrangements. M. Gariel, of the University of Paris, and Secretary of the French Association for the Advancement of Science, is in charge of the organization of the congresses, and a special building will be erected in the Exposition grounds for the meetings.

DR. TARLETON H. BEAN, who, as we reported last week, was asked by the President of the Park Board to resign the superintendency of the Aquarium, refused to do this, as no grounds were given for the request. The office has now been abolished, but it is understood that Dr. Bean will contest this subterfuge in the Courts.

ONE of the first appointments to the University Table at Naples is that of Dr. J. P. Halsey, who graduated at the College of Physicians and Surgeons in 1893, and since July, 1895, has been studying organic and physiological chemistry in Germany. He worked in Freiburg under Baumann until the latter's death, and since then in Strassburg under Hofmeister. He has just finished an investigation upon Tyrosin, and his plan at Naples is to experiment upon some of the lower organisms, which may throw light upon the origin of urea.

SURGEON-MAJOR DAVID PRAIN has been appointed Superintendent of the Royal Botanical Garden at Calcutta.

THE following appropriations were made during 1897, from the Bache fund, Natural Academy of Sciences:

March 18: To Professor A, S. Packard, for an investigation of the transformations of North American bombycine moths	$100
March 29: To Professor R. H. Chittenden, for an investigation of the poisonous fungi or toadstools of the country	500
April 29: To Professor Albert A. Michelson, for the construction of a new harmonic analyzer and integrator	400

May 1 : To Dr. John S. Billings, for an investigation of the colon bacillus group of organisms, being a continuation of the research upon the variability of bacteria, previously appropriated from the Bache fund..............	500
May 5 : Professor A. A. Michelson, for an investigation of a two-decimeter standard of length, which is to be determined in terms of the wave-lengths of red cadmium radiations by the interference method................	?
May 17 : To Professor Ira Remsen, for an investigation of the atomic weight of cadmium.	400
May 22 : To Alexander Agassiz, for assistance in paying part of the expenses of borings to be made in the Fiji Islands to determine the thickness of coral reefs........................	1,200
December 7 : To Professor A. S. Packard, for an investigation of the metamorphoses of the bombycine moths, in continuation of work already published in the last volume of Memoirs of the National Academy..............	100

THE following officers of the sections have been appointed, as we learn from *Nature*, for the Bristol meeting of the British Association: Section A—President: Professor W. E. Ayrton, F.R.S. Vice-Presidents: Professor Rücker, F.R.S., Professor S. P. Thompson, F.R.S. Secretaries: Professor A. P. Chattock, Professor W. H. Heaton (Recorder), J. L. Howard, W. Watson, E. T. Whittaker. Section B—President: Professor F. R. Japp, F.R.S. Vice-President: Professor W. Ramsay, F.R.S. Secretaries: Dr. C. A. Kohn (Recorder), Dr. T. K. Rose, F. Wallis Stoddart. Section C—President: W. H. Hudleston, F.R.S. Vice-President: E. Wethered. Secretaries: G. W. Lamplugh, Professor H. A. Miers, F.R.S. (Recorder), E. Wilson. Section D—President: Professor W. F. R. Weldon, F.R.S. Vice-Presidents: Professor F. Gotch, F.R.S., Professor L. C. Miall, F.R.S. Secretaries: W. Garstang, Dr. A. J. Harrison, W. E. Hoyle (Recorder). Section E—Vice-Presidents: Colonel F. Bailey, Dr. J. Scott Keltie. Secretaries: H. N. Dickson, Dr. H. R. Mill (Recorder), A. J. Herbertson, H. C. Trapnell. Section F—President: Dr. J. Bonar. Vice-President: Professor E. C. K. Gonner. Secretaries: E. Cannon, Professor A. W. Flux, H. Higgs (Recorder), W. E. Tanner. Section G—President: Sir John Wolfe-Barry, F.R.S. Vice-President: G. F. Deacon. Secretaries: Professor T. H. Beare (Recorder), H. W. Pearson, W. A. Price, Professor John Munro. Section H—President: E. W. Brabrook, C.B. Vice-President: C. H. Read. Secretaries: H. Balfour, J. L. Myers (Recorder), Dr. G. Parker. Section K—President: Professor F. O. Bower, F.R.S. Vice-President: Professor H. Marshall Ward, F.R.S. Secretaries: A. C. Seward (Recorder), Professor J. B. Farmer, J. W. White.

MR. WILLIAM OGILVIE, of the Geological Survey of Canada, gave a lecture to the Royal Geographical Society on 'The Geography and Resources of the Klondike Region,' on March 23d.

THE following are among the lecture arrangements at the Royal Institution, London, after Easter: Lord Rayleigh, three lectures on 'Natural Philosophy;' Dr. E. E. Klein, two lectures on 'Modern Methods and their Achievements in Bacteriology;' Mr. J. A. Thomson, two lectures on 'The Biology of Spring.' The Friday evening meetings of the members will be resumed on April 22d, when Mr. W. H. M. Christie, the Astronomer Royal, will deliver a discourse on 'The Recent Eclipse.' Succeeding discourses will probably be given by Professor A. Gray, Mr. E. A. Minchin, Professor W. A. Tilden, Mr. Justice Madden, Lieutenant-General Sir A. Clarke, Professor W. M. Flinders Petrie, Lord Rayleigh and others.

AN attempt is being made to establish a scholarship in botany at Barnard College in memory of the late Miss Emily L. Gregory, who was in charge of the department of botany at the College from its establishment.

SIR WILLIAM TURNER, who holds the chair of anatomy at Edinburgh University, has been asked to allow himself to be nominated for the presidency of the General Medical Council, vacant by the death of Sir Richard Quain.

DR. W. B. BENHAM, who succeeds the late Professor Parker in the chair of zoology in the University of Otago, New Zealand, has been given a dinner at Oxford in view of his departure from that University, and has been presented with a piece of plate by his present and former students.

THE Royal Academy of Sciences of Belgium has proposed eight questions for essays in 1898

and six questions for 1899. Prizes of the value of 600 fr. (in one case 800 fr.) are offered for the solution of each of these questions. Further details may be obtained from the Secretary, Palais des Academies, Bruxelles.

THE Schnyder von Wartensee foundation in Zurich will award, in 1900, a first prize of 3,000 fr. and other prizes amounting to 1,500 fr. for monographs on the peat moors of Switzerland.

THE botanical department of the University of Pennsylvania has received a gift of a collection of dried plants and seeds from the Biltmore estate and specimens of fungi from Dr. J. T. Rothrock.

ABOUT sixty original drawings by the late W. Hamilton Gibson, largely of entomological subjects, have been purchased for the departments of science and art of the Teachers' College, N. Y.

THE Massachusetts Senate has concurred with the House in voting an appropriation of $180,000 to continue the war on the gypsy moth.

THE Chairman of the House Committee on Military Affairs has introduced a bill increasing the number of medical officers in the navy by fifteen additional assistant surgeons, and authorizing the Surgeon-General of the Army, in emergencies, to appoint, with the approval of the Secretary of War, as many contract surgeons as may be necessary, at not exceeding $150 per month. The fifteen new men are to be appointed with the rank of First Lieutenant, after examination by an army medical examining board.

M. AUDIFFRED, member of the French Chamber of Deputies, has asked the French government to create French medical stations in China, in order to increase French influence in that country.

PROFESSOR FREDERIC STARR, of the University of Chicago, has returned from a trip through Mexico, having made important investigations on the Otomi Indians.

IT is stated in *Natural Science* that Mr. C. W. Andrews, whose stay in Christmas Island, S. Java, is extended for the requirements of his researches, has forwarded five more cases of specimens of natural objects to the British Museum.

THE most serious earthquake shock from which the Pacific coast has suffered for twelve years occurred just before midnight on March 30th. Many buildings were seriously damaged.

A PRELIMINARY meeting of the British committee formed to assist in the celebration, in May next at Lisbon, of the fourth centenary of the discovery of the Cape route to India by Vasco da Gama was held on March 21st at the rooms of the Royal Geographical Society. Sir Clements Markham presided and in a speech referred to the great geographical interest of the event which would be celebrated at Lisbon on May 17th to 20th, and said that a dinner and also a meeting would be held in connection with the celebration in May at the rooms of the Royal Geographial Society. Sir A. Rollit said it had been arranged to hold a meeting in May at the India Office, over which the Secretary of State had promised to preside, and the Department had also sent charts and plans to the exhibition at Lisbon. Resolutions of congratulation to the King and people of Portugal upon the occasion were passed and were cordially acknowledged by Sir Luiz de Soveral, and a sub-committee was appointed to carry out the arrangements.

THE British government does not seem inclined to assist greatly in an Antarctic expedition. In the House of Commons it has been stated that the Admiralty have been in communication with the Royal Society with reference to Antarctic exploration. The Board has been unable to promise cooperation either by the loan of ships or of officers, as officers cannot be spared at present for expeditions which may keep them away from their ordinary duties for long periods of time, but they have informed the Society that if they can render any assistance by the loan of instruments, or by any information which their experience enables them to give, they will be very glad to do so.

THE St. Petersburg correspondent of the London *Times* reports that on March 19th Drs. Jeaffreson and Lowry left St. Petersburg for Hangö with 70 northern dogs bought from the Samoyeds and destined for the forthcoming English expedition to the South Pole which is being fitted out by Sir George Newnes. These sledge dogs will be shipped from Hangö, the

nearest ice-free port from St. Petersburg, and taken on board the boat to be employed in the expedition, now lying at Christiania. Dr. Jeaffreson has been travelling during the winter in the wilds of the Petchora and the tundras of Kanin peninsula. This latter region, he found, had been given up almost entirely to a colony of pirates, who are probably the descendants of Russian criminals formerly banished to the region of Archangel. Last year they wrecked a Russian schooner, and the bodies of the crew were subsequently found by the help of dogs buried far off in the interior. Dr. Jeaffreson also explored the interior of the Yalmal Peninsula or Samoyed land, which has hitherto been almost unknown, and he intends, if possible, to organize an expedition to Novaya Zemlya."

A DESPATCH from Stockholm states that Herr J. Stadling, who accompanied Andrée's expedition to Spitzbergen in 1896, has been appointed by the Swedish Anthropological and Geographical Society to undertake a search through Siberia in order to make inquiries as to the fate of Andrée's balloon expedition. For this purpose Herr Stadling has received the Vega stipendium from the Society. He starts with a companion from Stockholm early in April, and the journey will last probably until January next.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Maryland House has concurred with the Senate, by a vote of 56 to 22, in appropriating $50,000 a year for two years to Johns Hopkins University.

THE proposed amalgamation of Harvard University and the Massachusetts Institute of Technology has been the subject of conferences between committees of both institutions, but the plan has now been abandoned.

THE University of Chicago has received a gift of about $150,000 from an anonymous donor.

MISS GOULD has given a further gift of $10,000 toward the endowment of the engineering school of New York University.

MR. CHESTER W. KINGSLEY, whose gift to Worcester Academy was reported last week, has now given $25,000 to Colby University.

THE governing board of the Sheffield Scientific School has established six new scholarships of $100, the equivalent of remitted tuition for the same number of students.

MR. HAROLD HEATH, now fellow of biology at the University of Pennsylvania, has been appointed assistant professor of zoology in Stanford University.

PROFESSOR F. W. CARD has resigned the chair of horticulture in the University of Nebraska, which he has filled for five years, and has accepted a similar position in the Rhode Island Agricultural College. His resignation takes effect in August and he assumes his new duties on September 1st.

CORNELIUS L. SHEAR, fellow in botany in the University of Nebraska, has been appointed Assistant Agrostologist in the Division of Agrostology of the U. S. Department of Agriculture, Washington, D. C., his duties to begin April 1st.

THE London University Commission Bill has been read a third time before the House of Lords and passed. It is said to be likely that it will also be passed in the House of Commons unless obstruction prevents its consideration.

THE University of Paris has been authorized to borrow 1,700,000 fr. for the construction on the rue Cuvier of buildings and laboratories for instruction in the sciences preparatory to the study of medicine, and for the completion of the laboratory of physiological botany at Fontainebleau.

THE government of Württemberg has just authorized the erection of a laboratory of hygiene in connection with the medical department of the University of Stuttgart.

SIR WILLIAM FRASER, formerly Deputy-Keeper of the Records of Scotland, who died on March 13th, has, by his will, left to the University of Edinburgh £25,000 for the foundation of a chair to be called the Sir William Fraser Professorship of ancient history and palæography, £10,000 for the purposes of the library and one-half of the residue of his estate, which is expected to amount to between £9,000 and £10,000, for general requirements, bursaries, research, publications, etc.

THE principalship of University College,

Liverpool, vacant by the appointment of Dr. Rendall to the headmastership of Charterhouse, has been filled by the election of Mr. Richard Tetley Glazebrook, M.A., F.R.S., Fellow and Senior Bursar of Trinity College, Cambridge. Mr. Glazebrook, who is a son of Dr. Glazebrook, of West Derby, was educated at Dulwich College and afterwards at Liverpool College, whence he obtained a scholarship at Trinity College, Cambridge. In 1876 he was fourth wrangler and in 1877 was elected a Fellow of his College. As an investigator he is best known for his researches in the higher branches of optics, and his chief papers have been on double refraction in biaxial crystals and on a dynamical theory of double refraction, both of which won high commendation from such authorities as Lord Kelvin and Sir Gabriel Stokes. He is also the recognized custodian of the British Association electrical units, now the standard for the world and is Secretary of the Electrical Standards Committee of the British Association.

MR. H. W. M. TIMS has been appointed professor of zoology in Bedford College, England.

AT Gonville and Caius College, Cambridge, the vacant Shuttleworth scholarships, each of the annual value of about £55, awarded for proficiency in botany and comparative anatomy, have been adjudged to Reginald Crundall Punnett for three years and to Harold William Atkinson, B.A., for two years.

SCIENTIFIC LITERATURE.

Living Plants and their Properties. A Collection of Essays. By JOSEPH CHARLES ARTHUR, SC. D., Professor of Vegetable Physiology and Pathology in Purdue University, and DANIEL TREMBLY MACDOUGAL, PH.D., Assistant Professor of Botany in charge of Plant Physiology in the University of Minnesota. New York, Baker & Taylor; Minneapolis, Morris & Wilson. 1898. Small 8vo. Pp. ix+234.

In recent years American botanists have generally been so burdened with the labor of botanical acquisition in systematic, structural or physiological fields that to a great degree their writings have been plain, matter-of-fact statements, interesting enough to other botanists, but quite unattractive to those not trained in the somewhat severe school of modern botany. This condition has invited and encouraged many mere 'writers'—pleasant wordmongers, with nothing more than the thinnest superficial knowledge of plants—to issue books to meet the demand made by reading people for information regarding the life of plants. It has often been my very unpleasant duty to point out the dreadful blunders which are certain to result from attempts at bookmaking by those whose pens run more easily and rapidly than their botanical attainments justify, and yet in nearly every case it has been found that the book with all its blunders sold well, which indicates that many people read it. There is a demand for *readable* books about plants.

When it was announced, a little while ago, that two of our most active plant physiologists were bringing out a book on living plants and their properties it was supposed that, as a matter of course, it would be a modern text book, for use in the physiological laboratories now happily increasing in numbers in our universities. What was our surprise, then, to find that the authors have given us a readable book on topics like these: 'the special senses of plants;' 'the development of irritability;' 'Mimosa, a typical sensitive plant;' 'universality of consciousness and pain;' 'how cold affects plants;' 'leaves in spring, summer and autumn;' 'the significance of color;' 'the right to live;' 'distinction between plants and animals.' In the first chapter, after a general discussion regarding the nature of the senses, Dr. Arthur takes up in order the senses which plants possess, *i. e.*, 'the sense of contact,' the 'gravity sense,' sensitiveness to light,' 'chemical sense' and 'moisture sense.' A single quotation from this interesting chapter will suffice to show the treatment (p. 14): "But what other senses have plants? I shall not attempt to show the numerous and interesting ways in which plants respond to light. Everyone knows how plants lighted from one side, as when placed before a window, bend toward the light. This is a true sensitiveness, for it results in bringing about definite movement. The stems place themselves parallel to the incident rays—that is, point toward the window; while the leaves

place themselves at right angles to the direction of the light—that is, with their upper surfaces to the window. Leaves and stems, therefore, show sensitiveness characteristic of each. Some stems, however, like those of Virginia creeper, turn away from light, enabling them to cling to dark walls. Roots, which are generally buried in the soil, rarely exhibit sensitiveness to light, and when they do it is usually to turn from it. If light comes to the organ from two directions it will bend toward the source of the stronger light, and differences which will affect the plant are far more minute than can be detected by the eye."

In a similar way Dr. MacDougal discusses 'how cold affects plants' (Chapter VI). After speaking of the general appearance of a frozen leaf, he says (p. 88): "If now a section is made of a frozen leaf it will be found that the spaces between the cells usually containing air are filled almost solidly with ice crystals. From whence is this ice derived?" * * * "Protoplasm even in its simplest forms is highly automatic and self-regulating. When the cells of a leaf are subjected to a low temperature they contract, and a portion of the water is driven out into the intercellular spaces, where it is frozen. By this provision the proportion of water in the cells is reduced and the danger of ice formation and consequent destruction is averted. If now the temperature is again lowered, an additional amount of water is forced into the intercellular spaces, rendering the cell-solutions still more concentrated, and less easily crystallized into ice." * * "It is thus to be seen that the extrusion of water into the intercellular spaces is a protective device of the protoplasm."

It is unnecessary to quote more from these suggestive chapters. These examples will sharpen the interest of every reader of this notice, who may be assured that this interest will not flag as he reads the pages for himself. The book will make an admirable addition to the scientific alcove of every public library.

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

Revision of the Orthopteran group Melanopli (*Acrididæ*), with special reference to North American forms. By SAMUEL HUBBARD SCUDDER. Proc. U. S. National Museum, Vol. 20, pp. 1–421, Plates 1–26. 1897.

This work by Mr. Scudder deals with a group of acridians of which the Rocky Mountain locust and the common red-legged locust are familiar forms. The Melanopli are essentially North American, and on account of the number of the species and the variety of the forms present great difficulties to the student.

A short introduction gives the characters and limitations of the group, and its geographical distribution; also an interesting note concerning the dimorphism in the length of the tegmina, and a statement as to the sources of the material used in the work, acknowledgments of aid received, and a few words as to certain details of presentation.

An elaborate analytical key to the genera is given, and there are also keys to the species of all genera not monotypic. These keys are successful in epitomizing a large amount of close study, and, with the aid of the figures, afford a ready means for the determination of the species; in all cases, however, the descriptions must be consulted for confirmatory data.

The key to the species of Melanoplus (pp. 124–139) is so long as to suggest that a separate tabulation of the groups, designated as series, and of the species under each group, would have been more useful.

The generic and specific descriptions are given with the detail characteristic of Mr. Scudder's work. Thirty genera are recognized and of these eighteen are described as new, of North American species 208 (113 new) are described. An analytical key to the Old World species of *Podisma* with brief notes, including descriptions of two new species, is also given.

The material upon which these genera and species are based has in most cases been ample, more than 8,500 specimens having been studied; of the 208 species but two are unknown to Mr. Scudder; 31 species are known from one sex only and 21 species from uniques. The females outnumber the males, 4,596 to 3,911, or, stated differently, in 96 species the females are the most abundant, in 75 species the males; in 37 species the numbers are the same. The bibliography and geographical distribution are given in admirable detail.

Plate one illustrates the venation of the tegmina of species of Phoetaliotes and of Melanoplus; the other plates, 2–26, show the abdominal appendages of the males of all but five of the species described.

In an appendix are given (1) a list of the heretofore described North American species with original and present nomenclature, (2) brief notes on undetermined forms, and (3) a list of South American Melanopli.

Mr. Scudder's contention (p. 187) for crediting *Melanoplus spretus* to Uhler can hardly be accepted; it is directly against the well-established canon that a name must take its authority from the author first defining it, and if admitted and generally applied would cause much instability in nomenclature.

Typographically both text and plates are well done; a few inaccuracies and omissions may be noted: page 76, Ann. rep. chief eng., the date 1877 should be 1876; page 267, Can. nat., and Bost. journ. nat. hist., the date 1868 should be 1862; page 270, the date of Fieber, Lotos, is given 1853 and on page 403 as 1854; page 360, the date of Serville, Orth., is given 1839 and on page 404 as 1838; page 403, *Pezotettix altitudinum* and *P. chenopodii* are omitted from the list, 1868 for *Pezotettix borealis* should be 1862, *Acridium differentiale* Uhler should be Uhler Ms. Thomas; page 404, 1879 for *Pezotettix marshallii* Scudder should be 1876.

SAMUEL HENSHAW.

Ethnological Studies among the Northwest Central Queensland Aborigines. By WALTER E. ROTH. Brisbane, Government Office. 1897. With 438 Illustrations. Pp. 199.

Mr. Roth was for several years surgeon to various hospitals in the districts south of the Gulf of Carpentaria, and had excellent opportunities for studying the languages and customs of the native blacks. The results he has condensed in the present volume. They rank among the most valuable contributions ever made to the ethnography of Australia, partly because the writer is a trained observer and careful narrator, partly because he made himself acquainted with the dialects of the tribes, without which knowledge it is vain to attempt an understanding of the ethnography of any people whatsoever.

One of his discoveries was that of the existence of a well-defined, manual-sign language extending throughout the entire district of his study, and indications of its presence elsewhere. Of these manual signs he presents 213 with their significations, some conveying simple, others complex ideas.

An excellent conspectus of the languages, grammatical, lexicographic and comparative, shows their structure and relationship. The intricate subject of personal nomenclature, consanguinity and class systems is clearly set forth and shown to be not the prevention of incest, as most writers have taught, but a scheme to regulate the proper distribution of the food supply. In this connection it may be added that he also corrects the common notion that the operation of introcision, practiced on the males, is for the purpose of limiting procreation. It has, in fact, no such effect.

The aboriginal food-supply is exhaustively considered. Cannibalism continues till this day in the outlying districts, and death from the most repulsive diseases does not prevent the corpse being eaten. Much information is added on implements, utensils, personal ornaments and trade or barter. Among these the various forms of the boomerang are described and figured. Of the message sticks Dr. Roth says positively that the designs upon them convey no significance and are intended merely to distinguish them from the sticks belonging to others.

The lines of barter are widely extended through Australia; their course is marked by certain signs and signal posts, easily caught by the native eye, and in spite of the constant wars a comparatively active commerce exists. One of the most interesting articles of barter is that of songs and dances (corrobborees). These are taught for pay (blankets, food, etc.) by one tribe to another. A tribe often sends picked men long distances to learn them, and, what is singular, the songs are frequently in a language wholly remote and unintelligible to the tribe buying them, but they are learned by rote and repeated with surprising accuracy (as the ignorant priest does his Latin liturgy).

The last chapter is entitled 'Ethno-pornog-

raphy' and relates the ceremonials by which the males and females are admitted to the rights of puberty and social rank. They are severe in the extreme, but are carried out inflexibly. No explanation of their rites is satisfactory, and that of the author, that it is merely for convenience, is no better than the others.

In the midst of the debasement reflected in the general condition of these tribes, it is interesting to learn that law and order, as they understand the terms, are maintained, and that a culprit is well aware of the punishment following his misdeeds and submits to it. When that punishment is death he quietly digs his own grave and awaits the spear thrusts which consign him to it.

The volume contains nothing on the physical anthropology of the natives and is very meager on their religious views.

D. G. BRINTON.

Iowa Geological Survey, Artesian Wells of Iowa. Vol. VI., pp. 115–428. By W. H. NORTON. Des Moines, State Print. 1897.

Although the subject of artesian wells and their utilization in the redeeming of the arid regions of the world commands general interest, still one would scarcely expect to find so much of interest to the unprofessional reader in the official report of a State Geological Survey.

The first section of Mr. Norton's report gives one an excellent idea of the artesian well in its historical development as well as in its present distribution, nomenclature and classification. These chapters will amply repay the untechnical reader and will also give the specialist a point of view which he is too apt to overlook in his application to details.

The remaining chapters are devoted to a very satisfactory and exhaustive setting forth of the records of the artesian wells of Iowa. Very many geological sections of individual wells and also of extended regions, together with full and conservative discussion, help to give one a very clear idea of the stratigraphic, hydrographic and hydrostatic conditions which exist in that State. In view of the interest attaching to the question of subterranean temperatures and the valuable information obtained from wells in the Dakotas northwest of Iowa by Mr. N. H. Darton, it is perhaps to be regretted that the report did not include the temperature of the flowing water, at least where the volume is considerable. From the popular explanation as to why these wells are called artesian, from Artois, instead of Mutinian, from Mutina, to the technical discussion of the stratigraphic conditions in their relation to sea-level, the volume is interesting and instructive; and although it is to be received chiefly as a contribution to our knowledge of the subterranean waters of Iowa, nevertheless it will serve as a valuable key to similar conditions in other localities.

W. HALLOCK.

The Mystery and Romance of Alchemy and Pharmacy. By C. J. S. THOMPSON. London, The Scientific Press (Limited). Pp. xv + 335. 12mo. Ill.

As foreshadowed in the title, the author of this work has not attempted a systematic history of alchemy and of pharmacy, but has gathered much curious information as to the mystery surrounding them in bygone ages and the romance associated with them. The first five chapters deal with the art of healing, the earliest fathers of medicine and the necromantic practices of the Greeks and Romans. In the sixth chapter we are introduced to the alchemists, and here the author shows his unfamiliarity with the results of modern historical researches; he states, for example, that the word chemistry first occurs in the writings of Suidas, whereas everyone knows that it is found six centuries earlier in the astrological treatise of Julius Maternus Firmicus, entitled *Mathesis.* Mr. Thompson also credits the Arabian Geber with knowledge of nitric acid, nitrate of silver and hydrochloric acid, as described in the *Summa Perfectionis* and *Liber Philisophorum* [sic], whereas Berthelot showed in 1893 that these Latin treatises are fraudulently ascribed to Geber, who had no knowledge of the mineral acids. To enhance the romantic and mysterious phase of his subject, Mr. Thompson has introduced several chapters on 'The Black Art,' 'Black Magic' and the occult sciences. The work is stronger on the medical side than on the chemical, the chapters on 'Curious Remedies,' 'Surgery in the Middle Ages,' 'Amulets,

Talismans and Charms,' being replete with curious lore. The sketch of 'Apothecaries and their Bills' throws light on early methods of pharmacy. The title of this volume would lead one to suppose that the romantic features of alchemy at the court of Rudolph II. might be included, but there is no reference to this German Hermes. It is ungracious to criticise a book by its omissions, but it is certainly singular to find no mention of the host of German alchemists who flourished under Rudolph II. and under Augustus of Saxony. Surely the careers of Sendivogius, of Richthausen, of Gustenhover and of Bötticher were sufficiently romantic! Part II. of the volume contains quotations of alchemical and pharmaceutical interest from the writings of Chaucer, Shakespeare, Spencer, Scott, Dumas and other authors. The illustrations are poorly selected, and there is no index.

H. Carrington Bolton.

SCIENTIFIC JOURNALS.

We have received from Messrs. Lemcke & Buechner, New York, the first issue of a bibliography of German periodical literature, compiled by Dr. F. Dietrich, and published in Leipzig by Fr. Andrä's Nachfolger. The Bibliography aims to accomplish for German literature what is done by the English 'Index to Periodicals' and our own 'Literary Index,' but pays relatively more attention to scientific journals. Technical science and medicine, including, it appears, physiology, etc., are however excluded, owing to the indexes already established. The present Bibliography, for the year 1896, contains about 8,500 titles from about 275 journals. It is a subject index, the entries not being made under the names of authors, which lessens its usefulness for scientific purposes. Such a bibliography, however, will prove of much value, and we cordially endorse the wish of the compiler that it may be subscribed for by sufficient libraries to pay the costs of publication and permit of its enlargement.

The *Psychological Index*, a bibliography of the literature of psychology and cognate sciences, has been issued for the year 1897. The compilers, Dr. Livingston Farrand, Columbia University, and Dr. Howard C. Warren, Princeton University, have this year been assisted by M. N. Vaschide, Paris, and Dr. B. Borchardt, Berlin, representing, respectively, *L'année psychologique* and the *Zeitschrift für Psychologie.* The value of the Index is greatly increased by the promptness with which it is issued. It will prove useful not only to psychologists, but also to men of science in other departments having some relation to psychology. No less than 2,465 titles are recorded for the year 1897. Their distribution may be given as an illustration of the field covered by modern psychology, general, 221 titles; genetic, comparative and individual psychology, 626; anatomy and physiology of the nervous system, 322; sensation, 142; consciousness, attention and intellection, 269; feeling, 102; movement and volition, 135; abnormal and pathological, 647.

The *American Journal of Science* for April opens with an article by Professor Langley on the bolometer. It has been used during recent years to make a map of the lower spectrum, but the publication of results has been delayed in the Government Printing Office, and Professor Langley here gives some account of the improvements that have been made since the instrument was first described. It is now about 400 times as sensitive as then, and will indicate a change of less than one-ten-millionth of one degree Centigrade. Mr. Arthur Durward contributes from the Jefferson Physical Laboratory of Harvard University a series of measurements of the temperature coefficients of the seasoned hard steel magnets whose induction coefficients have recently been investigated by Professor B. O. Pierce. Mr. Charles T. Knipp describes a new method of electrically giving seconds, without reference, however, to other similar devices. Other articles in the current number are: 'Skull of Amphictis,' by E. S. Riggs; 'Condition of Oxidation of Manganese precipitated by the Chlorate Process,' by F. A. Gooch and M. Austin; 'San Angelo Meteorite,' by H. L. Preston; Pre-Glacial Decay of Rocks in Eastern Canada,' by R. Chalmers; 'Datolite from Guanajuato,' by O. C. Farrington; 'Clinohedrite, a new mineral from Franklin, N. J.,' by S. L. Penfield and H. W. Foote, and 'Rhodolite, a New Variety of Garnet,' by W. E. Hidden and J. H. Pratt.

THE *Popular Science Monthly* gives a portrait of Charles Semper as frontispiece and contains a sketch of his life. The most interesting article in the number is one by Professor W. K. Brooks on 'Migration,' but many will read with equal interest the article on 'Evolution and Teleology,' by Dr. J. A. Zahm, presented before the recent Catholic Scientific Congress. Among the other papers is one on 'Criminal Anthropology in Italy,' by Miss Helen Zimmern, and one on the 'Electric Transmission of Water Power,' by Mr. William Baxter, Jr. The number also contains three extended articles on economic topics.

THE *Astronomical Journal* for March 28th is greatly enlarged to make place for Dr. T. J. J. See's discoveries and measures of double multiple stars in the southern hemisphere. The first catalogue contains 500 entries, the results of work during the first year and four months at Flagstaff and Mexico.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON—290TH MEETING, SATURDAY, MARCH 26.

THE evening was devoted to a 'Symposium on the Comparative Value of Factors Influencing the Distribution of Life,' the subject being introduced by Dr. C. Hart Merriam, whose remarks were particularly directed to those factors governing the distribution of terrestrial life. The most important of these he considered to be temperature, next humidity and the elevation of the base level. The effects of the general slope of elevated regions was discussed and its influence in extending or curtailing the various life zones according as the slope was towards the north or south. The twofold effect of streams was dwelt on, particularly of rapid mountain streams, along whose sides is a narrow border of northern forms, while valleys produced by erosion permit the entrance of southern species.

Dr. L. O. Howard spoke of the distribution of insects and considered the prime factors to be: 1. Temperature as influencing all groups; 2. Distribution of food plants as influencing phytophagic species and the species dependent upon them; 3. The capacity of the species to conquer in the struggle for existence; 4. The influence of civilization. He dwelt especially upon the complicated inter-relationships among insects and showed that restriction in distribution due to an apparently obvious cause might in many cases in reality be due to a perfectly blind cause, due to these interrelations of forms.

Dr. W. H. Dall spoke of the distribution of aquatic mollusks, considering temperature to be the preponderating factor, largely so through its effects on very young mollusks. Thus adults could live and thrive where the temperature was fatal to the young. Pressure was stated to have little effect, some species ranging from a depth of three fathoms to 1,700 fathoms. Abyssal forms were said to be of wide distribution, while those found above 500 fathoms were generally derived from littoral species.

Mr. F. V. Coville, speaking of plants, said that the factors influencing their distribution were in some respects quite different from those affecting animals. For example, plants had no power of choice and could not remove from the place when their seeds fell, however unsuitable it might be. The temperature of the soil was another powerful factor affecting plants, as well as the character of the soil itself and its drainage, and, above all, the amount of moisture it received.

Dr. Theo. Gill said that temperature was an element affecting large aggregates of animals and that other causes influenced the smaller groups. The geological history of the earth had very much to do with the present distribution of terrestrial life; and while temperature was the great factor in determining the extent and character of marine faunas, temperature subject to the lay of the land governed the distribution of life on land.

Mr. B. E. Fernow said that the struggle for existence must be taken into account and that the ability of a plant to adapt itself to the environment frequently accounted for an extended or restricted range. Thus a plant of limited range in one country, when removed to a region where it was not subject to the competition of other forms, might spread with great rapidity.

Professor B. W. Evermann spoke of the influence of great drainage areas on fresh-water fishes

and the effect of the character of the bottom over which streams flowed.

F. A. LUCAS,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the regular meeting held on Wednesday, March 23, 1898, Professor C. R. Van Hise, of the U. S. Geological Survey and the University of Wisconsin, made the principal contribution. It was on Crystalline Schists and Rock Flowage. The propositions advanced were radical, and to state them within the limits of a single paragraph and without the evidence will not be attempted. The paper will, of course, be published in due time.

Mr. Geo. Otis Smith, U. S. Geological Survey, spoke on the 'Igneous Phenomena in the Tintic Mountains, Utah.'

The Tintic Mountains, he said, are situated in the Great Basin, but do not belong to the Basin range type. They possess an axis of closely folded Paleozoic strata, which were deeply eroded in Mesozoic time, while later the area became the seat of volcanic activity. The earliest eruption was of quartz-porphyry and rhyolite. The next eruption was andesitic and a well defined cone of tuffs and lavas, now deeply dissected, can be seen on the western slope of the range. The vent is filled with an agglomerate containing large blocks of Paleozoic quartzite and limestone. This earlier andesite series, largely fragmental, is capped by very extensive flows of mica-andesite and pyroxene-andesite.

A dioritic mass covers an area of several square miles on the western slope. On the north this rock cuts the Carboniferous limestone and includes blocks of the quartzite and limestone hundreds of feet in diameter. Here the rock is a typical granular hornblende-diorite. On the south the intrusive mass breaks across the volcanic cone and the rock is a diorite-porphyry. Dikes from this mass extend into the tuffs and connect with the overlying andesite flows. On the crest of the range no division line can be drawn between the andesite flows and the diorite-porphyry intrusive. In a continuous rock-mass a perfect gradation is seen between a granular diorite and a glassy andesite. The dioritic intrusive is, therefore, the youngest rock of the area and occupies the stock or neck through which the later flows of andesite were erupted.

The meeting closed with a brief description, by Mr. A. C. Spencer, of a 'blow-out' near Mancos, Colorado.

W. F. MORSELL.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 482d meeting of the Philosophical Society was held March 19th, at the Cosmos Club, at 8 p. m. The first paper of the evening was by the President, Professor F. H. Bigelow, on 'The State of the Philosophical Society. An interesting table of statistics was presented and discussed, from which encouraging conclusions were drawn in regard to the future work of the Society. The second paper was by Mr. Herbert Friedenwald, on 'The Declaration of Independence—a Summary of Colonial Grievances.' In the address the following facts were brought out and emphasized :

The Declaration as a political document marks a significant point in the history of the Revolution. Jefferson was chosen to draw it up because of his familiarity with colonial history, and because of the feeling that he was the fittest man to summarize the grievances of the colonies. In so doing he omitted no material point in the 'long train of abuses,' and the Declaration, therefore, is a brief, yet eloquent, account of the political contest that waged between England and America for more than a hundred years.

It has not been so viewed by the historians of the period, with the result that from no histories is it possible to get at the true meaning of the counts in the indictment against King and Parliament.

Each of these charges was then taken up in turn and, from a study of the sources, was elucidated.

E. D. PRESTON,
Secretary.

ENGELMANN BOTANICAL CLUB.

THE Club met at the Shaw School of Botany on Thursday, March 10th, thirty-three members present. Professor William Trelease dis-

cussed the plans for the formation of a catalogue of the local flora. He made numerous suggestions as to methods for collecting the lower plants, illustrating his remarks with specimens. Three new members were elected.

The Club met again on March 24th, thirteen members present. Dr. N. M. Glatfelter exhibited specimens of *Salix cordata* and discussed the adnacy of their filaments as well as reduplication in some cases. He showed that adnate filaments, partial or more or less complete, are quite common, a circumstance never mentioned before by authors. Two free stamens in this species have always been recognized heretofore, and only that acute observer, W. Barratt (in Monograph of North American Willows), admitted two or *three* free stamens. Dr. Glatfelter exhibited specimens having three to five filaments with as many anthers. The filaments were united in various ways, sometimes in sets of two each, sometimes four all joined half way, in several cases even five, more or less grown together. One or two anthers were usually imperfect. The specimens were taken from a tree of *Salix cordata* var. *vestita*.

Another series of specimens of *Salix cordata* $\times$ var. *vestita* $\times$ *S. sericea* were exhibited, showing matured catkins which had not been pollinated, as the staminate flowers had all disappeared much earlier, thus limiting the further propagation of this particular form. Three new members were elected.

HERMANN VON SCHRENK,
Secretary.

NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY AND MINERALOGY, MARCH 21, 1898.

THE paper of the evening, illustrated by lantern, was by Dr. Heinrich Ries, entitled 'The Clay and Kaolin Deposits of Europe.' Dr. Ries sketched briefly the geographical distribution of the kaolin deposits and their relation and comparison to similar deposits of America. He then gave special attention to the deposits of Great Britain, Belgium, Denmark, Germany and Austria, and mentioned briefly those found in other regions. He described particularly the deposits of Cornwall, which are found in association with veins of tin in granite areas, where it is supposed that the feldspar has been changed to kaolin through the influence of fluoric fumes rising from below. These products are very pure, containing ninety-seven and one-half per cent. of clay substance. He also spoke of the ball plastic clays found in southwestern England, which occur in lenses in large beds of sand and are used to mix with non-plastic kaolins. Refractory clays are found in England and Scotland in the Carboniferous rocks and are worked by underground mining. Impure clays, used for bricks, are particularly found in the vicinity of London. The Staffordshire blue brick, Fuller's Earth and Bath brick deposits were sketched briefly, and the technological treatment in Great Britain, Germany and the United States was compared. The latter part of the paper was devoted to a rapid summary of the position, quality, uses and manner of mining of the famous clays of Bornholm, Denmark; of the Glasspot clays of southeastern Belgium; of the kaolin deposits of Limoges, France, and the deposits of Prussia.

Professor Henry F. Osborn described the progress made this year, through international effort, in correlating the larger divisions of the fresh-water Tertiary deposits of Europe by a study of the vertebrate remains.

Professor James F. Kemp was elected chairman of the Section and Dr. Heinrich Ries secretary for the ensuing year.

RICHARD E. DODGE,
Secretary.

NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE regular monthly meeting of the Society was held on March 11th at the College of the City of New York, Dr. Wm. McMurtrie in the chair. On recommendation of the chairman, speaking in behalf of the Executive Committee, the time for the election of officers was changed from the October to the June meeting, to allow the newly elected officers an opportunity to prepare the work for the ensuing year during the summer months. Dr. Bogert called the attention of the members to the fact that anyone interested in zoo-chemistry and wishing to do research work in that direction might avail him-

self of the benefits of the John Strong Newberry fund.

The first paper on the program was a paper by W. P. Mason, describing a 'New Bacteria Counter.' In the absence of Professor Mason, the paper was read by Dr. Bogert and illustrated by an example of the apparatus described.

The second paper was by Dr. J. H. Stebbins, on the 'Action of Sulphuric Acid on Thymol.' Dr. Stebbins exhibited some photographs of the crystals of the compounds formed in his investigation.

A paper by Messrs. Wm. K. Alsop and J. H. Yocum, on 'The Composition of the Ashes of Some Raw Tanning Material,' was read by Mr. Yocum. One of the interesting points emphasized by the author was the large amount of manganese found in some of the ashes, rather unusual in the vegetable kingdom.

P. H. Conradson described 'Some Laboratory Experiments on Standardizing and Investigating Viscometers.' Dr. Conradson mentioned that there were about as many viscometers as there were oils, and that they all left a great deal to be wished for. He gave a very interesting description of the various kinds in use, illustrating his remarks by charts and drawings. A general discussion followed.

The session was closed by a paper on the 'Technology of Glue,' by E. R. Hewett. Dr. Hewett gave a very complete description of the manufacture of glue, including its history and chemistry, and also exhibited a large number of specimens.

Durand Woodman,
Secretary.

ALABAMA INDUSTRIAL AND SCIENTIFIC SOCIETY.

The eighth annual meeting of this Society was held in the city of Birmingham, March 4, 1898, President Truman H. Aldrich in the chair. Twenty members and a number of visitors were present. The Secretary, in making a report upon the statistics of mineral production, called attention to the difficulty encountered in inducing the producers to send in their returns promptly, and suggested that the Society recommend that the representatives from Jefferson County to the next General Assembly be requested to amend the State Mining Law in such a way as to secure prompt returns. A committee consisting of the Secretary, J. A. Montgomery and J. D. Hillhouse was appointed, to draw up the desired amendment. Professor Henry McCalley, exhibited and explained to the Society a manuscript map of the Warrior Coal Field, prepared under the auspices of the Geological Survey and soon to be published, on which were shown the outcrops of all the important coal seems of that region. Dr. William B. Phillips, gave a short account of his recent examinations of some brown ore deposits near Leeds, and made some remarks concerning the probable mode of formation of the ore beds. Dr. Phillips also gave an account of some experiments recently carried out by himself and others in Pittsburg upon the coking of some Alabama coal from the Pratt seam, in a by-product plant. The experiments were most satisfactory, and the Doctor expressed the opinion that when this by-product plant was put in operation in Alabama a number of small industries which use these products would soon spring up.

The reports of the Secretary and of the Treasurer were then rendered. The Society has at this time 41 active members, and this number was increased at the meeting by the election of seven new members.

The address of the retiring President was then delivered, in which the object and aims of the Society were recited and some of the results pointed out which had followed from its efforts. He also made some suggestions as to what the Society might further undertake. The annual election of officers was then held with the following result: President, Professor M. C. Wilson, of Florence; Vice-Presidents, J. G. Moore, of Blocton, and Chas. J. Geohegan, of Birmingham, the four other Vice-Presidents holding over being Joseph Squire of Helena, James H. Fitts, of Tuscaloosa, Jno. A. Montgomery, of Birmingham, and J. W. Minor, of Thomas. The Treasurer, Henry McCalley, and Secretary, Eugene A. Smith, were continued. The meeting then adjourned until some time in May, next. After the meeting the members and visitors dined together.

Eugene A. Smith,
Secretary.

SCIENCE

FRIDAY, APRIL 15, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE DEVELOPMENT OF PURE FOOD LEGISLATION.*

IT has become customary for the retiring President of the Chemical Society of Washington to present an address on some subject of interest to chemists. If the theme happens to be one which is attracting the attention of thoughtful people generally it is none the less welcome for that reason. We are American citizens first, then chemists.

For the honor of addressing the Pure Food Congress this evening I am indebted to a happy coincidence, in point of time of the meeting of the Chemical Society with the assembly of this Congress.

The chosen topic will not, I trust, prove uninteresting to the larger audience, though it was selected and much of the material collected before the call for the present Congress was issued. I ask your attention for a short time to a review of legislation concerning food adulteration.

The foods and food stuffs of the most civilized people of early historic times were, as compared with ours, few and simple. They had no market filled with all manner of foods in an advanced state of preparation. The food materials they sold and bought were mainly raw and crude,

* Address of the retiring President of the Chemical Society of Washington, delivered before a joint session of the Society and the Pure Food Congress, March 2, 1898.

and their preparation for use was a duty of members or servants of the family. They had neither potted meats nor canned vegetables. When there were 'two women grinding at the mill' the meal was made of such grain as the householder furnished. Spices came to them unground and with none of their virtue extracted. The list of fine family groceries was a very short one. Our far-away fore-bears lived closer to nature and knew less of art than we. Food adulteration as a great evil follows manufactures and commerce and flourishes in the train of a broadening civilization. A disposition to defraud was not wanting to the ancients, but skill to invent and large opportunity to apply are modern.

Early Greece had inspectors of wines to prevent adulteration. Pliny records that that in Rome bread was sometimes adulterated with mineral matter, and says that sophistication of wines was prevalent and pure wines difficult to obtain, but it does not appear that corrective legislation was attempted or proposed.

We find sanitary regulations concerning the sale of food, however, among the teachings of Moses in the wilderness and in the Rabbinical laws which were given to the Jews at a very early date. The early Jews, be it remembered, were distinctly a people of this world. They had practically no conception of a future life. Moses scarcely referred to a future existence. His life was devoted to the elevation of his people, and it is not conceivable, with all his versatility and breadth of judgment, that he did not have in mind the sanitary bearing of the laws he gave to his nation. Rather, is it probable, that he sought to elevate simultaneously the physical, moral and spiritual natures of his followers. And considering the low state of their civilization, it is suggested by high Jewish authority that he deemed it best to surround his directions with the glamour of mystery and superstition. "Ye shall do no unrightousness in judgment in mete-yard, in weight or in measure; just balances, just weights, a just ephah and a just hin shall ye have." This command had reference to commerce in general, but I feel warranted in mentioning it here because similar requirements have commonly been included in pure food laws. It was commanded that the animals which were offered as sacrifices, portions of which were used as food by the priests and Levites, should be without blemish, and that no meat should be eaten more than two days after the slaughter of the animal. It is probable that this was intended to influence the Jewish nation as a whole to eat only fresh meat and that from sound animals. In fact, the Rabbinical law comes to our assistance and requires that all animals used as food by the Jews shall be slaughtered by a priest, who shall carefully examine the lungs and other vital organs to determine if any disease be present, and that no meat shall be eaten more than two days after the slaughter of the animal. It is further provided by both the Biblical and Rabbinical laws that meat shall not be eaten from any animal which died otherwise than at the butcher's hand.

The range of possible adulterations at this time was necessarily very limited and required for its development a corresponding growth of commerce and manufacture.

Passing to the eleventh century we find the world emerging from the Dark Ages. The schoolmen were occupied with metaphysics and theology. Their discussions seem to us unimportant and often trivial, and they were never utilitarian, but they mark an advance toward systematic, scientific thinking. Under their influence new universities were established and those of earlier origin received a fresh impetus. A beginning was made in the literature of the Romance languages, the study of the ancient languages was revived and the Arabian

schools of Spain worked over and added to the conglomeration of unclassified theories and facts from which the various departments of science have been developed. Feudalism, whatever its faults, had averted the chaos which for a time threatened to follow the death of Charlemagne and was fostering and augmenting personal honor, the spirit of independence and the love of liberty. Of course, no general laws were possible or necessary at this time, but we find regulations enforced in some cities forbidding the adulteration of wine and beer. Of all foods these were the most important from a commercial standpoint and were most commonly adulterated. Since then there has never been a time when their adulteration was not restricted by legislation and each succeeding period increased the list of foods thus protected until the entire field was covered.

With the dawn of the thirteenth century we find eastern Europe greatly advanced in education and civilization. The Crusades have broadened the minds of their participants. Manufactures have become more diversified, commerce has made a corresponding growth, and a spirit of exploration has sprung up, opening new lands to the advancing civilization. In England and in France the common people have been given a voice in the legislative bodies, and it is worthy of note that contemporaneously with this popular quickening and awakening, or as a direct and immediate sequence, the protection of foods was made a subject of frequent legal enactments.

In 1202, thirteen years before the signing of the Magna Charta, the 'Assize of Bread' was enacted in England. In 1266, the year following the formation of the House of Commons, a statute was enacted forbidding the sale of unwholesome wine and meat. This law was in force more than four hundred years, when it gave place to a more general law. In 1286 the 'Assize of Bread' was repealed by a more comprehensive act known as the 'Statute of Assize.' This statute was intended to control the size and weight of the loaf, not to prevent adulteration. Its effect was naturally to increase adulteration at first, but additions were made from time to time, as their necessity became apparent, to include all frauds in bread.

During the latter part of this century the adulteration of beer was forbidden in France, and in London it was unlawful to adulterate spices by substitution with foreign matter or inferior goods, or by increasing their weight with water.

In the fourteenth century numerous incidents are recorded of punishment by pillory for short weight and for selling bad bread and putrid meat. Early in the fifteenth century Henry V. issued a proclamation against the adulteration and mixing of wine, prescribing the pillory for offenders. In France it was decreed in 1336 that adulteration and exhausted drugs should not be offered for sale nor used in the preparation of any compounded article. The police departments of French cities adopted food and sanitary regulations, and in 1382 the Prevost of Paris declared it illegal for millers to employ cheaper cereals for admixture with their flour, a form of adulteration most difficult to deal with and most dangerous to commerce at the present day. Fourteen years later the artificial coloring of butter was forbidden as well as the mixture of old butter with new. A few years later it was ordered in Paris that butter should not be sold in the same shop with any article having an offensive odor.

In Germany at this time the food supply was controlled in the various cities by trade organizations, which seem to have had full power to adopt standards, pass judgment and punish offenders. These guilds, as they were called, existed in a large number of trades and regulated the workmanship

of their members as well as the quality of goods sold. The penalties they inflicted were often severe and always humiliating. Among them may be mentioned expulsion from the guild, exposition in the pillory, emersion in muddy water and public whipping. Indeed, instances are recorded in which the offenders were burned at the stake. Finally, a Biebrich dealer was sentenced to drink six quarts of the adulterated wine with which he supplied his customers, an early instance of making the punishment fit the crime.

The fifteenth century brings with it the mariner's compass, the practical application of the art of printing, the organization banks, important maritime discoveries and a rapid growth of manufactures and commerce. In this century, however, and in the three succeeding, comparatively little progress was made in pure food legislation, though the practice of adulteration increased with the growth of commerce. From time to time the wine and beer laws were made more stringent. In the sixteenth century Censors appointed by the College of Physicians in England were empowered to investigate and punish irregularities in the sale of drugs and in the practice of medicine. Clauses prohibiting the sale of adulterated goods were included in the Danish code, and pharmacopœias were compiled in England and Germany in the seventeenth century, and in the eighteenth century laws were passed in England which had for their purpose the increase of the revenues by means of regulating the adulterations of coffee and tea.

In four centuries, however, no great progress in food legislation was made, nor was it possible till iatro-chemistry had ceased to exist, till the phlogiston theory had become a thing of the past, and the balance and the microscope had enabled us to judge of the purity and quality of the food we examine. Before the present century it would have been impossible to enforce a general food law because of the lack of methods to detect adulterants. A single illustration of the crudeness of the early methods will suffice. In the sixteenth century Ale-tasters were appointed in England, whose duty it was to examine all ale before it could be sold. They were instructed, among other things, to pour a little of the ale they were examining on a bench and sit on it, and if their leather breeches stuck to the bench the presence of added sugar was definitely proven.

In 1802 the Conseil de Salubrité was established in Paris, and similar organizations in other cities and some of the provinces soon followed. These committees gave close attention to the question of food adulteration and the progress made in this direction in the first half of this century was largely due to them. During the same period laws were passed in England relating to the adulteration of several articles of food. The penal codes in the Netherlands and in the Scandinavian peninsula contained clauses regulating the sale of adulterants and damaged goods, which have only been rigidly enforced within the last forty years.

The middle of the present century marked a new and most important era. The methods of quantitative analysis had for the first time been effectively applied to the examination of foods. The microscopist had made great progress in his field, and more than a beginning had been made in the study of vegetable histology. Adulterants which might and did pass without suspicion twenty or ten years earlier were then detected with certainty, and the analyst could follow the manufacturer and discover each new cheat as it took the place of an old one which had been exposed. It must not be supposed, however, that all abuses were immediately corrected, or even that the progress of reform was easy and rapid.

In England advocates of a general and efficient food adulteration law were not wanting, but the people at large were apathetic and Parliament was more concerned with party questions than with measures that, while promising little party advantage, were threatened with strong opposition. Trained analysts were few and far between, and in the absence of standards there was no end of conflict and jealousy among the few experts.

The London *Lancet* has earned the gratitude of the civilized world by its early, earnest, fearless, persistent and finally successful advocacy of food adulteration laws. It was in a position of commanding influence and it stood for public welfare. The *Lancet's* Analytical Sanitary Commission, established in 1850, with Dr. Arthur Hill Hassell as chief analyst, waged a determined warfare on food and drug adulteration for a period of nearly twenty years, in fact until comprehensive laws had been enacted and their efficiency demonstrated. The Analytical Sanitary Commission made reports from time to time of the analyses of a large number of foods, drinks, drugs, confections, tobacco, etc., it being the first to undertake this work in any systematic way. Naturally, opposition in every form was excited and became active, vigorous and determined. The Commission and the editor of the *Lancet* were threatened with legal prosecution and personal violence. In the House of Commons Sir Charles Wood, Chancellor of the Exchequer, quoted as the opinion of the 'most distinguished chemist of the day' the assertion that 'neither by chemistry nor by any other means' could the admixture of chicory with coffee be detected, the falsity of which assertion Dr. Hassell demonstrated with the microscope. The protection of coffee from adulteration by chicory which itself had been adulterated with parsnips and other roots was the first practical achievement of the Commission, although the question of coffee adulteration and the sale of coffee substitutes was considered from the standpoint of revenue rather than of fraud.

In 1854 Dr. Hassell published 'Food and its adulterations—comprising the reports of the Analytical Sanitary Commission of the *Lancet* for the years 1851 to 1854 inclusive.' Before the publication of these reports in the *Lancet* it was notorious that many articles of food were generally adulterated, but nothing was known with the precision necessary to suppress fraud. Conclusive evidence of the value of the Commission's revelations, which had a wide circulation in Dr. Hassell's book, is found in the fact that reforms in food laws were immediately pressed in Parliament.

Nor was the movement confined to England. In 1855 the French law relative to foods, which had been in force since 1851, was amended to include drinks, and progress was made in Spain, Denmark and other countries. In the same year the Select Committee on the Adulteration of Food was appointed by Parliament and began an investigation, summoning before it a large number of witnesses, embracing chemists, microscopists, manufacturers, wholesale dealers and consumers, but no general law was passed until 1860. In the same year, 1855, Dr. Letheby was appointed Medical Officer for the city of London, a position which had been sought with much earnestness by Dr. Hassell, both of whom had been prominent in the agitation for pure food laws.

A work 'On the Composition of Food, and how it is Adulterated, with Practical Directions for its Analysis, by W. Marcet, M.D., F.C.S., etc., appeared in 1856. Dr. Marcet devotes a considerable space to disparaging the work done by Dr. Hassell, and the *Lancet* reviews Marcet's book with marked severity.

Jealousies among the advocates of reform

in food laws are noticeable in all the discussions of this period, and doubtless they had no small effect in delaying the passage of an efficient food law. At the least they furnished weapons for an open opposition which drew its inspiration from the profits of adulteration.

In 1857 Dr. Hassell published a second book entitled 'Adulterations Detected: or Plain Instruction for the Discovery of Frauds in Food and Medicine.'

During this period of discussion and waiting in England the French were dealing with offenders under their national and municipal laws forbidding the preparation and sale of adulterated articles of merchandise and the use of incorrect weights and measures. The penalties under these laws were publication, fine and imprisonment. Dealers convicted under municipal laws were compelled to post conspicuously in their places of business large placards with a confession, in detail, of their guilt.

In 1860 Parliament passed the 'Adulteration of Food and Drugs Act,' which made it illegal, first, to sell any article of food or drink with which, to the knowledge of the seller, any article or ingredient injurious to health had been mixed; second, to sell as pure or unadulterated any article of food which was adulterated or not pure. The appointment of analysts was optional with boards of health, church vestry and other bodies. The prescribed fees, ranging from a half crown to ten shillings, were hardly sufficient to pay the cost of materials required for the analysis.

The law was a beginning, but scarcely more. The failure to establish standards and provide for the certain appointment of inspectors and analysts, and the provision making proof of 'guilty knowledge' necessary to conviction, insured the failure of the law as a practical measure. Indeed, these defects were plainly and persistently pointed out before the passage of the act, and it is difficult to escape the conclusion that among those who voted for its passage were some who knew how to 'run with the hare and hold with the hound.' With only a few trained analysts, each of them jealous of the others, and with no recognized standards, it seems the time had not come for a more efficient food law in England than that of 1860.

The agitation was continued and in 1872 the Act of 1860 was re-enforced by the 'Act for the Prevention of the Adulteration of Food and Drinks and of Drugs,' (35 and 36, Vic. C. 74). This act provided for the appointment of inspectors, did not require the proof of 'guilty knowledge' for conviction under the charge of selling adulterated foods, and was applicable to drugs as well as foods. In correcting one of the flaws in the Act of 1860 by not requiring the proof of 'guilty knowledge,' a serious mistake was made in affording no protection to retail dealers, and much injustice resulted.

The dissatisfaction produced by the shortcomings of this act were called to the attention of Parliament by numerous petitions from all the larger cities. The result was the appointment, in 1874, of a second Select Committee, which advised that the act be amended. The committee also expressed the opinion that much of the injustice complained of was due, not to the act itself, but "to the want of a clear understanding as to what does, and what does not, constitute adulteration, and in some cases to the conflicting decisions and inexperience of the analysts."

As the result of the investigation and report of the Select Committee, legislation was again attempted the following year.

"An Act to repeal the Adulteration of Food Acts and to make better provision for the Sale of Food and Drugs in a pure state" (38 and 39 Vic. C. 63, 11th Aug., 1875).

Sec. 1. Repeals former statutes.

Sec. 2. The term 'food' is defined as including every article used for food or drink by man other than drugs and water. The term 'drug' includes all medicines for internal or external use.

Sec. 3. "No person shall mix, color, stain or powder * * * * * any article of food with any ingredient or material so as to render the article injurious to health, with intent that the same may be sold in that state, and no person shall sell any such article so mixed, colored, stained or powdered, under a penalty in each case not exceeding fifty pounds for the first offense; every offense, after a conviction for a first offense, shall be a misdemeanor, for which the person, on conviction, shall be imprisoned for a period not exceeding six months with hard labor."

Sec. 4. Prohibits the mixing of drugs with injurious ingredients and the selling of the same.

Sec. 5. Exempts in case of proof or absence of knowledge, and of ability 'with reasonable dilligence to obtain that knowledge.'

Sec. 6. "No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance and quality of the article demanded by such purchaser, * * * * *."

Sec. 7. Provides for the sale of compound articles of food and compound drugs.

Sec. 8. Provides that the affixing of a legible label, stating that the goods are mixed, shall be a sufficient protection against conviction by this act.

Sec. 9. Prohibits the abstraction of any part of an article of food with intent to sell without notice of such abstraction, and the selling of such article without notice.

I refer to only a few of the sections of this law. As a whole it was far better than any legislation that had preceded it in England or in any other country, yet owing to the peculiar constructions placed upon it by the magistrates, convictions, even in cases of evident violation of the act, were difficult and often impossible to secure.

A clear idea of the chief legal difficulties which confronted those charged with enforcing the Sale of Food and Drugs Act can be given by quoting from 'An Act to Amend the Sale of Food and Drugs Act' (42 and 43 Vic. C. 30, 1879):

Sec. 2. "In any prosecution under the provision of the principal act for selling to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance and quality of the article demanded by such purchaser, it shall be no defense to any such prosecution to allege that the purchaser, having bought only for analysis, was not prejudiced by such sale. Neither shall it be a good defense to prove that the article of food or drug in question, though defective in nature or in substance or in quality, was not defective in all three respects."

Sec. 6. "In determining whether an offense has been committed under section 6 of said act by selling, to the prejudice of the purchaser, spirits not adulterated otherwise than by the admixture of water, it shall be a good defense to prove that such admixture has not reduced the spirit more than twenty-five degrees under proof for brandy, whisky or rum, or thirty-five degrees under proof for gin."

A few special acts have since been passed from time to time, but their importance is relatively insignificant. The Act of 1875 as amended in 1879 constitutes in greater part the food law of England as existing at the present time.

The enforcement of these acts at first was difficult and uncertain. As has been previously stated, experienced analysts were few, and the remuneration offered was not sufficient to induce reliable and competent men

to undertake the work. More than this, conflicting decisions by the magistrates before whom the cases were tried added to the difficulties of enforcing the acts. The word 'adulteration' itself received various definitions at the hands of those charged with enforcing the law.

As the intention of the law became more generally understood, standards in all classes of foods were adopted. Legal questions were settled and the machinery for enforcing the acts reduced to working order. In consequence, there has been a constant improvement in the quality of food in the English market, until at the present time there is no government which more completely protects its people from adulterations in food.

So much attention has been given to English law because of the important effect it had in influencing the legislation of other countries. An example of a good working law was offered, a law which had not only outlived the jealousies and misunderstanding of the friends of reform, but had overcome the most skillful, determined and persistent opposition of its foes. In the framing of all subsequent laws in other countries the English law has been carefully studied and the experience gained in the thirty years' contest between the friends and foes of pure food legislation has saved much loss of time and misspent effort.

The machinery for enforcing the law must necessarily vary with the form of government. Sometimes standards have been in cluded in the laws, again other provisions have been made for the adoption of standards.

Since 1880 governmental supervision of the food supply has become general among the nations of the world. In some countries we find scarcely any article of food left unprotected by general enactment. In others the laws are less comprehensive. Where modern civilization is just superseding the ancient order the laws are confined to city ordinances, while in outlying districts where only simple foods are used there is no occasion for restriction.

It is my conviction that in centralized governments the state of a nation's civilization may be judged with accuracy by the protection it affords its people in the quality of the food sold. The absence of national food laws hitherto in the United States may not be well understood in other countries, but it is plain to all who understand the limitations of our federal government. Municipal and State laws, in some cases models of their kinds, we have; but the necessity of a national law, covering the whole question in its relation to manufacture and commerce in the District of Columbia and the Territories, the commerce between the States and between the States and the District of Columbia and the Territories, and to our foreign commerce, is becoming apparent to all thinking men. By no other means can we hope to secure laws uniform in their scope, requirements and penalties among ourselves, and for our foreign commerce nothing less can avail.

We have come upon an era of intense competition and consequent small profits in manufacturing. It often happens that the success, even the life, of an honest business depends on protection from the competition of debased or otherwise fraudulent products. Without protection it becomes a question with the manufacturer whether he shall give up his business or his integrity. Never before did the adulteration of food present so strong temptations to the manufacturer. It is true, indeed, that the fraudulent manufacturer often employs his chemist to help him perpetrate and conceal fraud, and thus adulteration has become a fine art. But there are always honest manufacturers and dealers ready to come to the aid of the health officer. Never before was protection so sure. We can almost say that

if any food adulterant runs more than a short course now, the fault must be charged to inefficient food laws.

Let us protect the honest manufacturer and dealer at every point against the unfair competition of dishonest rivals. Let our products stand on their own merits—stand or fall. And let the same rule apply to imported goods.

I have tried to obtain refined cottonseed oil from our leading grocers, but have rarely succeeded except at four times its value and under another name. Our native wines, superior to the common wines of any other country, are creating for themselves an increasing demand in foreign countries under their proper labels. Why, then, should we allow them to receive fictitious names at home? Let us by all proper means promote the use of American maize at home and abroad, but always as maize —not as wheat! Let us eat plain American herrings, if we choose, but not 'French sardines' from the coast of Maine. Let us stop the sale of 'pure imported Lucca oil' from the cotton fields of Georgia. Whether as a matter of morals or from policy, let us have honesty.

W. D. BIGELOW.

COLOR VISION.

OF late years the subject of color vision seems to have been specially stimulating to students of psychology, if a judgment may be based upon the rapid increase in the number of hypotheses advanced to explain it. The last of these is briefly outlined in a recent issue of SCIENCE (Feb. 18, 1898), having been brought forward by Professor Patten, of Dartmouth College, at the meeting of the American Physiological Society during Christmas week, and based upon his observation of the fibrils in the eyes of invertebrates. On the assumption "that the length and angular relations of a fibril determine the amount of its response to a wave of light of a given length and plane of vibration, it is possible to offer a logical explanation of many phenomena of color vision."

Every investigator recognizes the necessity of hypotheses as antecedent to theories. The contrast between these may be briefly expressed in the definition of Flourens: "A hypothesis is the explanation of facts by possible causes; a theory is the explanation of facts by real causes." The wave theory of light was a hypothesis until it became fortified by a mass of evidence, mathematical and experimental. The most important single experiment was that of Foucault, who showed that on passing from air into water the velocity of propagation of light is diminished, as it should be according to the wave theory, while according to the emission hypothesis it should be increased. This crucial experiment alone would have been sufficient to change the wave hypothesis into a wave theory. Professor Patten's view of color vision is announced as a 'new theory.' This word is, indeed, so generally employed as a synonym for hypothesis that it may, perhaps, be as well to accept the mandate of usage, insisting always, however, upon a distinction between established and unproved theories. No existing theory of color vision has been established upon evidence comparable with that on which the wave theory of light rests. This fact should not prevent psychologists from forming and testing new hypotheses; but when there is so large a number of these offered for choice in relation to a single subject all persons other than the originators have good excuse for conservatism. Any one whose domain is not psychology should be content with indefinite suspense of judgment until psychologists quite generally agree upon one theory of color sensation, as physicists have agreed upon one theory of propagation of the waves which give rise to color.

Without a fuller statement than that recently given, it would be unfair to criticise Professor Patten's hypothesis. No physicist should criticise anything more than the assumption that the length and angular relations of a fibril determine the amount of its response to a wave of light of a given length and plane of vibration. To be valid the assumption should imply that each fibril has a definite rigidity in a definite plane so as to respond to special transverse vibrations. The subject scarcely offers a field for mathematical examination, and direct disproof is impossible. If this hypothesis is destined to outlive its announcement it must be because it is found to serve better than other hypotheses for the explanation of such troublesome visual phenomena as phosphenes, after-images and simultaneous color-contrast. Even if it should stand this test the physicist will probably be cautions about either attacking or sustaining it.

So far as the phenomena of physics are linked with those of sensation, it is natural that physicists should quite generally entertain a high respect for the conclusions reached by Helmholtz, an investigator who as a physiologist took rank with the most accomplished of his contemporaries, and whose brilliant work in physics can be judged by physicists more readily than that in physiology. When his important work on Physiological Optics was published, in 1866, the 'new psychology' was yet unborn. Even to-day it is not easy to assign a dividing line between psychology and the physiology of brain and nervous system. The hypothesis of color vision originated by Young, and revived after a half century by Maxwell and Helmholtz, has served a very useful purpose as a working hypothesis for physicists, and under present conditions it bids fair to serve them yet for a number of years in the same capacity. On such an extra-physical subject as sensation the physicist has scarcely any choice but to accept the consensus of opinion among the leaders in physiology and psychology. If the latter are irreconcilably at variance among themselves—and every new 'theory of vision' seems to emphasize this inference—the physicist must retain the working hypothesis which has been already found useful, however unsatisfactory it may be to those who are at variance. It may be perfectly legitimate for him to recognize, and even emphasize, what seems unproved in his working hypothesis, and thus openly profess his uncertainty. This cannot be greater than the uncertainty with which he would join some faction of the psychologists. If he wishes to test all the theories of color vision now offered him he must give up physics to a considerable extent and study psychology enough to become an investigator in this subject.

Without attempting to refute any one hypothesis of color vision, it may be sufficient to say that there are now at least seven of these presented as competitors for favor, four out of the seven having been announced during the last half dozen years. First is the Young-Helmholtz hypothesis; then comes that of Hering, which was its only competitor until 1887, when Wundt published his important paper entitled 'Die Empfindung des Lichts und der Farben.' In 1892 appeared Mrs. Franklin's 'Eine neue Theorie der Lichtempfindungen,' which was followed in 1893 by Ebbinghaus's 'Theorie des Farbensehens.' Still another competitor was brought forward by Nicati in 1895, to be followed in 1897 by the new American competitor just announced. The bewildered physicist is already a fit subject for commiseration, and apprehension about the future tends to make him yet more unhappy. He despairingly beseeches the psychologists to agree among themselves, but they will not agree; on the contrary, the prospect seems to be

that additional color hypotheses will continue to appear until from their abundance they cease to receive attention.

Competition is the normal condition of progress. 'Lernfreiheit' is, and must continue to be, the watchword of the student of science. In the evolution of psychology every hypothesis has a right to announcement. Whether it drops at once out of sight, or receives general and serious consideration, must depend upon its consistency as judged by those whose fitness to judge has been demonstrated. The workers in neighboring departments must content themselves with suspense of judgment until the result of the survival of the fittest is established.

Assuming, then, that in the present condition of disagreement among psychologists the oldest hypothesis of color vision is apt to continue in favor among physicists, it may be well to note a few points upon which we may be justly dissatisfied with it, these points being taken chiefly on physical rather than psychological grounds.

According to the Young-Helmholtz hypothesis in its modern form there are three fundamental color sensations, which may be expressed graphically by overlapping curves of intensity. The simultaneous excitement of all three in appropriate proportion gives the sensation of whiteness. The deficiency of the retina in capacity to respond to one or more of the stimuli corresponding to these sensations determines a special kind and degree of color-blindness.

This idea of fundamental sensations has a rather peculiar history, as was pointed out more than twenty years ago (*Am. Journal of Science*, April, 1875) by the late Professor A. M. Mayer. Dr. Thomas Young was a contemporary of Dr. Wollaston, the discoverer of the dark lines in the solar spectrum. Newton had considered the spectrum to be made up of seven colors. Of these red, yellow and blue were thought the most important, and were called primary colors, not with reference to any theory of color perception, but because by mixture of pigments of these three hues in suitable proportions all the other hues could be obtained, though with loss of purity and especially of brightness. These derived colors were, therefore, called secondary. This Newtonian view is thus not a theory of color vision in any proper sense. Young at first taught the Newtonian view, but subsequently changed his selection of primary colors on account of some erroneous observations made by Wollaston. In the Bakerian lecture, 'On the Theory of Light and Colors,' read before the Royal Society in 1801, under the heading 'Hypothesis III.,' Dr. Young wrote: "The sensation of different colors depends on the different frequency of vibrations excited by light in the retina." He further adds: "Now, as it is almost impossible to conceive each sensitive point of the retina to contain an infinite number of particles, each capable of vibrating in perfect unison with every possible undulation, it becomes necessary to suppose the number limited; for instance, to the three principal colors, red, yellow and blue, of which the undulations are related in magnitude nearly as the numbers 8, 7 and 6." He thus refers the production of color sensation to the co-vibration of special particles, set up by waves of special period, just as a tuning fork co-vibrates with another similar fork sounded in its neighborhood. He supposes that, like the tuning fork, 'each of the particles is capable of being put into motion, less or more forcibly, by undulations differing less or more from perfect unison,' and that 'each sensitive filament of the nerve may consist of these portions, one for each principal color.'

Dr. Young was avowedly not much given to experiment. He was an acute observer,

and highly original, but he avows: "For my part, it is my pride and pleasure, as far as I am able, to supersede the necessity of experiments, and more especially of expensive ones.'' Wollaston, in 1802, undertook his observations on the solar spectrum, using a prism of flint glass, a substance at that time comparatively new, hard to obtain in large pieces, and often blemished with veins. It is not surprising that his work should have been crude in comparison with that of the skillful optician, Fraunhofer, who a dozen years later rediscovered the solar lines and mapped them. Of the few lines discovered by Wollaston the most prominent were considered by him to mark the natural boundaries between the chief spectral colors. The *A* line, if we may here use Fraunhofer's notation, was thought by Wollaston to be the exact limit of the red; the *D* line to separate red from green; the *G* and *H* lines to be the natural boundaries of the violet. In Young's Natural Philosophy, published in 1807, he refers to the work of Wollaston, who, he says, 'has determined the division of the colored image or spectrum in a much more accurate manner than had been done before.' Referring to Wollaston's method, he adds: "The spectrum formed in this manner consists of four colors only, red, green, blue and violet." Referring to some of Newton's work in obtaining secondary hues he concludes: "We may consider white light as composed of a mixture of red, green and violet, only in the proportion of about two parts red, four green and one violet, with respect to the quantity or intensity of the sensations produced." In this volume Dr. Young makes no reference to the hypothesis of color perception which he had advanced in his Bakerian lecture a few years previously. Whether he had given it up or not is left to inference only. Despite his apparent indifference to experiments, he seems to have set the example, between 1802 and 1807, of appealing to the rotation of disks to show that gray may be obtained by the mixture of red, green and violet, quite as well as with Newton's seven colors, red, orange, yellow, green, blue, indigo and violet. He says: "The sensations of various kinds of light may also be combined in a still more satisfactory manner by painting the surface of a circle with different colors, in any way that may be desired, and causing it to revolve with such rapidity that the whole may assume the appearance of a single tint, or of a combination of tints, resulting from the mixture of the colors." Half a century seems to have elapsed before this fruitful method was taken up again by Maxwell and Helmholtz, and its valuable results have been still further extended by Rood, Abney and others.

When Helmholtz discovered the long-forgotten theory of Young he was professor of physiology at Heidelberg. The respect in which he is held by all physicists has very naturally caused them to repose confidence in the conclusions reached by him as a physiologist. This fact creates quite generally a prejudice in favor of the hypothesis of Young, which is accepted by them as a working hypothesis, even though its assumptions be far from proved. It has the merit of great simplicity. It can be grasped without any extended study of the technicalities of psychology. This is obviously no argument to prove its truth, but in the present condition of the subject, in the confusing multiplicity of color hypotheses and the apparent hopelessness of the struggle to establish anything definite that psychologists will agree upon as a substitute for the hypothesis which Helmholtz has offered to the physicists, simplicity with admitted uncertainty is for many of us preferable to the championing of a new hypothesis which is challenged by half a dozen other hypotheses supported by names of varying authority in the world of science.

What physicists need to be reminded of is the fact that Helmholtz's hypothesis is just as uncertain as some of the newer ones. Since the physicist, as such, deals only with the phenomena of color, and not at all with its specific effect on the brain, it can really make little or no difference with him what hypothesis, if any, of those now competing for supremacy shall win at last. But physicists cannot be expected wholly to withdraw their interest from subjects essentially separate but closely related to physics. It is of definite importance, therefore, that they should have some appreciation of the uncertainties which they may be tempted to treat as long established verities.

What, then, is a 'primary color,' or a 'fundamental color sensation?' Young seemed to think that a primary color is one of the minimum number whose mixture as lights produces white. This definition can hardly be accepted to-day. Physically there is no reason why any hue of given wave-length should be named primary in preference in some neighboring hue whose wave-length is slightly greater or less. The three primaries assumed by Maxwell were red, green and blue, the selection of wave-length for each standard being not definitely fixed. With the use of appropriate colored glasses for absorption in front of an electric lantern, the production of white on a screen by mixture of these three hues is easy enough. By the same method it is equally easy to produce white by the mixture of yellow and blue, or with any other pair of complementaries, such as red and the mixture of green and blue, which has been called peacock. If we take $\lambda = 0.58\,\mu$ for the yellow, and $\lambda = 0.47\,\mu$ for the blue, and thus succeed in obtaining white, the components of this, or of any other pair of complementaries, may be thus called primaries. Or, if we mix peacock, purple and yellow, which are the complementaries of red, green and blue, respectively, the white attained is quite satisfactory. If a triplet of colors be deemed necessary, therefore, peacock, purple and yellow may be called the primaries, though it might be harder to designate the purple by any single wave-length. It is thus quite indefinite to speak of a primary as one of a minimum number of hues whose mixture produces white.

A primary has been otherwise defined as a hue which is incapable of being produced by the mixture of any other two hues. Red is thus called a primary, while yellow is distinctly not such. But the yellow due to a mixture of red and green is always deficient in purity, and a similar comment may be made upon the result of any color mixture. If violet be called a primary, as one of Young's triplet, it may be replied that by suitable mixture of red and blue a violet may be obtained that is quite as good of its kind as the yellow obtained by mixing red and green. If blue be called a primary, as one of Maxwell's triplet, it may be replied that by suitable mixture of peacock and violet a good blue may be produced. If green be called a primary it may be produced, though with considerable admixture of gray, by mixture of peacock and yellowish green. It thus appears that red is about the only hue to which this definition seems to be fully applicable. Admitting it, therefore, as a primary, the selection of its companion primaries is still uncertain.

Whatever may be the definition finally agreed upon for 'primary color,' the corresponding sensation is the 'fundamental' sensation. A very large amount of time and labor has been spent in the effort to obtain curves that shall correctly represent these fundamental sensations. The curves as estimated by Helmholtz are shown in Fig. 1, and have long been familiar. In the figure they are adjusted, not to the prismatic, but to the normal spectrum. It is seen that the maxi-

mum for the red is in the brightest part of the spectrum affecting the eye as red; it would ordinarily be called scarlet. The maximum for violet is likewise in the brightest part perceived as violet; it would be called a bluish violet, or almost ultramarine. The maximum for green is in the brightest part of the green. Maxwell's curves, obtained experimentally by use of his color-box (Phil. Trans., 1860), differ from those estimated by Helmholtz. The maxima for red and green are each shifted very decidedly toward the yellow, while that for the violet is in the typical blue.

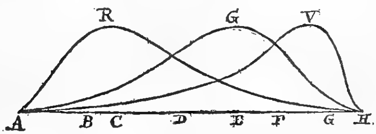


Fig 1.

An elaborate investigation was undertaken, under the direction of Helmholtz, by Koenig and Diderici, and published in 1886. (*Sitzungsberichte der Koeniglich Preussischen Akademie der Wissenschaften zu Berlin*, 22 Juli, 1886.) This was based on the examination not only of those having normal eyes, but of several persons with different grades of color-blindness. No English translation of this paper has thus far been published, and it is to be regretted that some parts of it are wanting in clearness, if judged by American standards. The collective color equations were deduced from observations with a Helmholtz color-mixing apparatus, but the reader is informed that "the experimental details demand for their representation so much space that we cannot here go into them." The final result is shown in the curves of Fig. 2, which should be compared with those of Fig. 1. It is seen that the violet curve extends here from the H line only to the D line; that the green curve extends into the violet and red regions, but by no means to the ends of the spectrum; and the red curve reaches but little beyond the F line in the blue. The violet maximum is

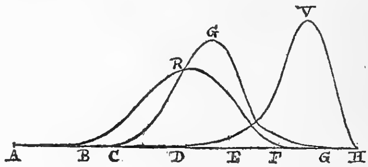


Fig 2.

at $\lambda = 0.445\,\mu$, corresponding to ultramarine. The green maximum is at $\lambda = 0.545\,\mu$, corresponding to a yellowish green. The red maximum is at $\lambda = 0.564\,\mu$, which corresponds not to red, orange, or even pure yellow, but to a slightly greenish yellow. This is so wide a departure from the earlier ideal curve of Helmholtz, and from Maxwell's result, that one is tempted to ask whether there may not have been some very arbitrary assumption involved in the deduction of one or the other. The overlapping of the curves emphasizes the well-known fact that even the most nearly pure of spectral colors near the middle of the spectrum are decidedly impure. Taking account of this fact, the authors reach the conclusion that the pure fundamental sensations would correspond to hues about as follows: for red, $\lambda = 0.671\,\mu$, which is near the red end, between the B and C lines, instead of the maximum, of the red curve; for green, $\lambda = 0.505\,\mu$, a slightly bluish green, which is close to the intersection of the green and violet curves, instead of the maximum of the former; and for violet, $\lambda = 0.470\,\mu$, a pure blue, which is decidedly nearer the middle than is the maximum of this curve. The reader is not favored with the calculations by which these wide differences are found between the curve-maxima and the spectral positions corresponding to the fundamental sensation hues.

In the construction of the curves by Koenig and Diderici it should be observed that the areas are made the same. Red, having the greatest extent of different wave-lengths included in the sensations, has the least height. Violet, having the least extent, has the greatest height. The corresponding ordinates, therefore, must not be confounded with the ordinates representing relative brightness. Of all the spectrum colors violet has the least brightness. The proper distribution of ratios for brightness is shown in Fig. 3, which is due to Captain

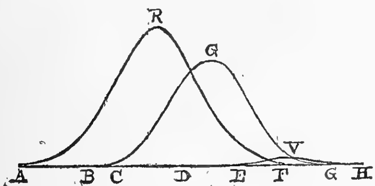


Fig. 3.

Abney, and made from very careful observations with his 'color-patch' apparatus after the publication of the work of Koenig and Diderici. They agree quite well with Rood's results obtained twenty years ago, so far as brightness is concerned (Modern Chromatics, p. 34). These curves additionally show maxima quite different from the ones just discussed. Abney's red maximum is between the C and D lines, corresponding nearly to scarlet; his green maximum in the yellowish green, and his violet maximum in the blue; all of which seems much more consistent than the result obtained by Koenig and Diderici.

In the face of these diversities between the results of highly skilled observers, all of whom have assumed the truth of the Young and Helmholtz hypothesis, it may, perhaps, be asked whether physical investigation of this difficult subject has settled us upon much firmer ground than that occupied by the opponents of this hypothesis. The history of the idea of primary colors shows that scientific precision has not been its chief characteristic. We are perfectly sure that there are some hundreds or thousands of different hues represented by different wave-lengths which produce effects upon the retina, no one of which has any better claim than any other to be considered primary. As a matter of convenience there are certainly great advantages to be derived from suitable grouping of these wave-lengths, but it may be well questioned whether there is any physiological or psychological basis for such grouping. If it is only a matter of convenience has there not been an enormous amount of labor expended in the attempt to find a foundation that is only imaginary? The phenomena of color-blindness are the ones of most importance in this connection. Red blindness is the most common, green blindness almost equally so, and violet blindness so rare that it is in practice hardly taken into account. A glance at Abney's curves shows that this is what ought to be expected. But deficiency of color sense for red is often accompanied with less marked deficiency for yellow, green and blue, and there seems no good reason for considering any one of these deficiencies more fundamental than any other. We may continue to use the color-sensation curves, and find that, instead of indicating uncertainty about the true hues of primary colors, they merely show natural diversity among the different individuals subjected to examination. We may still use the Young and Helmholtz hypothesis as the simplest and most convenient representation of color phenomena, but with large reservation and prudent silence about primary colors. These we may rightly call prominent colors, while we profess our total ignorance about the way in which they affect the retina or the brain. This condition of somewhat discon-

tented ignorance we can maintain until our friends, the psychologists, finally settle upon some one theory after this is fortified with evidence of such a character as to exclude its competitors. Their authority will then be accepted as readily as they now accept the authority of the physicists about the polarization of light or the mechanical equivalent of heat.

So far, therefore, as physicists accept the Young and Helmholtz hypothesis their acceptance must be based, not on any physiological grounds, but upon its convenience of application to the phenomena of color mixture and color analysis. Practically, one hypothesis may, perhaps, be no better than any other for this purpose, If we abandon the term 'primary color,' and substitute 'prominent color' for it, our selection may be determined avowedly by convenience. In the performance of the extended work of color analysis, which was undertaken a few years ago under the direction of Professor Rood for a well-known firm of publishers, the composition of all compounds was expressed in terms of black, white and five 'standard colors,' red, orange, yellow, green and blue. The standard pigments selected were English vermilion, mineral orange, chrome yellow, emerald green and artificial ultramarine, all of which give enduring and reliable hues. Violet was left out because no sufficiently reliable pigment was obtainable; but by mixture of appropriate proportions of standard red, blue and black a good violet was included in a selected series of types. There is no danger of practical inconvenience to the physicist because of the present unsatisfactory conditions relating to color theory.

To give the outlines of the competing views is hardly necessary. The Hering hypothesis is well known, and probably universally rejected among physicists. Wundt's hypothesis has a good following among psychologists, but is still very little known among physicists. Without pretending to be a psychologist, I am much more favorably impressed with this hypothesis than with that of Hering. Mrs. Franklin's views need not be outlined, as they are readily accessible, in either the English or German language. With the hypotheses of Ebbinghaus and Nicati I have not yet become acquainted. Physicists will, perhaps, not be surprised at this frank confession.

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THE EPARTERIAL BRONCHIAL SYSTEM OF THE MAMMALIA.

THE paper deals with the structure of the bronchial system and pulmonary vascular supply of the mammalia as exhibited by corrosion in an extensive series comprising representative types of all orders and many families. The conclusions reached are, in the main points, at variance with the views expressed by Professor Aeby and generally accepted in the current text-books of Human and Comparative Anatomy. For reasons given in detail in the paper, the primitive form of the mammalian bronchial distribution appears to be Aeby's 'bilateral hyparterial type.' The arrangement of the primary bronchial trunks and of the pulmonary artery exhibited in this type is of considerable morphological importance in reference to the evolution of the typical mammalian bronchial tree, and is discussed at length in the paper. Aeby's researches revealed but a single form possessing this distribution, viz.: *Hystrix cristata*, the European Porcupine. Subsequently, M. Weber described the same type in the lungs of *Balæna mysticetus* and *B. antipodum*. The present investigations have added a fourth form to the list, *Taxidea americana*, the American Badger.

In examining the lungs of the remaining

mammalia which were investigated, a distinct and progressive series can be established in accordance with which the various conditions of bronchial distribution and vascular supply may be derived from the primitive type found in *Hystrix* and *Taxidea*. This series is illustrated in the paper by a selection of the following seven forms: *Canis familiaris*, *Dicotyles torquatus*, *Myrmecophaga jubata*, *Auchenia glama-pacos*, *Cebus capucinus*, *Cebus niger*, *Phoca vitulina*.

Aeby's 'stem bronchus' and its monopodic system of lateral branches, characteristic of the majority of mammalian lungs, appears to be derived from the tracheal bulla or lacuna with dichotomous division of the primary branches found in *Hystrix* and *Taxidea* by further development and relative rearrangement. The typical 'stem bronchus' develops from three segments of the primitive bronchial tree.

1. Proximal portion, between the bifurcation and the origin of the primary cephalic trunk, is derived by further segmentation and division of the tracheal bulla.

2. The second segment of the stem bronchus is formed by the primary caudal trunk of the primitive lung.

3. The third segment is continued caudad as the representative of the medial secondary caudal branch of *Hystrix* and *axidea*.

The general conclusions reached in the paper may be summed up as follows:

1. The right and left lung agree morphologically in the type of their bronchial distribution.

2. The asymmetry, when observed, is apparent, not real, depending usually upon complete separation of the right primary cephalic trunk into two components, the proximal one of which changes its original relation to the bronchial stem and pulmonary artery by migration cephalad. More rarely the asymmetry depends upon the complete migration cephalad of the entire cephalic trunk carrying both secondary branches (*Myrmecophaga*).

3. Aeby's hypothesis of the morphological equivalence of the middle right and upper left lobe of the human lung is therefore untenable.

The proposition should read:

RIGHT LUNG.		LEFT LUNG.
Upper + middle lobe	=	upper lobe.
Lower + cardiac lobe	=	lower lobe.

4. The active agent in changing and modifying the architecture of the lung is *not* the pulmonary artery (Aeby), but the *migration* of the cephalic primary trunk, or of its proximal secondary derivative, usually only on the right side, producing apparent asymmetry. This migration affords an opportunity for more complete development of the resulting terminal bronchial system and for consequent increase in respiratory area.

5. In the majority of mammals this greater development of respiratory surface is confined to the right side, resulting in the formation of the so-called 'Eparterial Bronchus,' and also indicated by the development of a special accessary cardiac bronchus of the right side.

6. Except, therefore, for purposes of topography, the distinction of Eparterial and Hyparterial bronchi should be abandoned, at least to the extent of clearly recognizing the fact that in asymmetrical lungs, every right 'eparterial' bronchus finds its morphological equivalent among the 'hyparterial' bronchi of the left side.

7. The impropriety of ascribing any morphological significance to the number of pulmonary lobes is apparent. The division of the lung into lobes is an entirely secondary character, not dependent upon the type of bronchial distribution, but probably connected with the unequal mobility and rate of expansion in different segments of the thoracic walls.

8. For reasons detailed, the primitive type of the mammalian lung is the symmetrical 'bilateral hyparterial' form, the symmetrical 'bilateral eparterial' form representing the *end-stage* in the process of evolution, not the *primary type* (Aeby, Wiedersheim).

9. The primitive type of division is practically dichotomous (*Hystrix, Taxidea*).

We can recognize two main trunks on each side, one cephalic, the other caudal. The cephalic trunk supplies the anterior and middle portions of the lung, the main migratory modifications in the different types taking place within its region of distribution. The caudal branch supplies the posterior and larger portion of the lung.

In the subsequent development of the stem-bronchus and its monopodic type of branching, characteristic of the majority of mammalian lungs, the following factors are active:

a. Complete segmentation of the primitive tracheal bulla, producing the usual bifurcation. This establishes the proximal portion of the stem-bronchus, and gives to the primary cephalic trunk the position of a lateral branch derived from the same.

b. The caudal continuation of the stem-bronchus is composed of the representative elements of the primary caudal trunk and its medial secondary branch, the lateral secondary branch and additional lateral accessory branches developed subsequently appearing as the 'ventral branches of the stem-bronchus' (Aeby).

c. The cardiac bronchus usually appears as a special accessory branch derived from the stem-bronchus of the right side only (Exception *Auchenia*).

10. In the majority of forms examined, the pulmonary artery is not dorsal to the stem-bronchus, except in the terminal portion. The position, as Narath has pointed out, is lateral or dorso-lateral.

11. Hence the distinction into 'dorsal' and 'ventral' branches, separated by the pulmonary artery in Aeby's sense, should be abandoned.

12. The results above outlined agree with the conclusions reached by Narath in regard to the equivalence of the anterior or cephalic branches of right and left side in asymmetrical lungs. They differ in the interpretation of the derivation of the 'Apical bronchus,' which he regards as the dorsal branch of the first ventral bronchus, and in the above outlined phylogenetic development of the stem-bronchus and its monopodic system of branching.

The conclusion of the paper deals with the probable causes which lead to the migratory changes in the relative position of the cephalic branches.

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SINGULAR STRESS-STRAIN RELATIONS OF RUBBER.

Since the stress-strain diagrams from rubber were published in this Journal of date of February 19th, last, the investigation has been somewhat extended. In all cases the same curious behavior was noted and the same peculiar differences compared with other materials. In all cases the substance behaved under load precisely as do other materials in the early part of its strain; then a reversed curve is described and the test-piece stiffens greatly and offers continually increasing resistance until, at last, rupture takes place, without yielding by inelastic deformation at any point in its course. Toward the end of its test the substance yields proportionately to the applied load. The fracture is sharp and without warning and the break clean and smooth and at right angles to the line of pull. No permanent reduction of section is observable after fracture. The reduced section immediately before breaking was

but one-eighth the initial section of the unstrained rubber.

Permanent set occurs to an exceedingly slight extent, and its value is dependent upon the maximum load and independent of the elastic properties of the substance. The set of the material would not be noticed in ordinary use. Permanent loads produce permanent, continuous, extension and, in time, fracture. This was found to be true for loads rising from 40 to 330 pounds per square inch (2.8 to 23.18 kgs. per sq. cm.), and stress-strain diagrams for two weeks under small loads showed steady elongation.

Plotting curves having for their coordinates loads per unit of area and areas of section of test-piece at point of maximum reduction, the stress-strain diagram thus produced becomes altered in form and similar to those of other materials plotted in the usual manner. It has the same curvature at the initial stage, the same straight line to an (apparent) elastic limit, and finally a steady, but slight, rise with increasing loads, with a sudden break at the end. The highest load measured in these experiments was 810 pounds per square inch (56.7 kgs. per sq. cm.). The quality employed, in all cases, was that of the stationers' elastic bands.

In this connection a recent article by Professor R. A. Fessenden has peculiar interest. He had noticed that, on making a fresh cut in a piece of rubber and then stretching it, using a microscope to reveal any peculiarities of appearance, the surface showed a curious sponge-like structure, with odd little excrescences gradually protruded, as the strain was increased, exuding from the pores of the substance. He thus indicates the existence in the material of two components: a hard and horn-like substance, and a jelly-like matter in its pores. He finds the same in other highly elastic substances. He offers a curious, but none-the-less notable, theory to account for the properties of this singular material.* The practically perfect elasticity exhibited in the experiments here described, as made in the Sibley College laboratories, lends confirmation to many of the ideas presented by that investigator, who indicated the form of the elastic curve for this curious substance in advance of its determination by experiment, and who based upon his theory of its construction explanations of its thermodynamic properties and actually produced, artificially, substances having similar elastic† properties.

R. H. THURSTON.

SIBLEY COLLEGE, CORNELL UNIVERSITY,
March 15, 1898.

*Journal of the Franklin Institute, September, 1896. See also Watts Dictionary, First Edition, Vol. II., p. 738—Caoutchouc.

† Thus: Sodium stearate, dissolved in 5 to 20 parts hot water and permitted to set as a jelly, gives, when cold, stress-strain diagrams like those of caoutchouc. When squeezed dry by hand, however, this compound becomes at once brittle and powdery. As a jelly it behaves like animal muscle in many ways and is polarized to electric waves.

BRADNEY BEVERLEY GRIFFIN.

THROUGH the untimely death of Bradney B. Griffin, who died on March 26th at the age of twenty-six years, zoology has lost an able student and a promising investigator. He was the son of Dr. Bradney Griffin, of New York, and received his earlier education at the College of the City of New York, where he graduated in 1894. Mr. Griffin then became a graduate student in zoology at Columbia University, where he subsequently won a fellowship and took part in the zoological expeditions to the northwest coast, sent out by that institution in the summers of 1896 and 1897. He was the author, wholly or in part, of several papers relating to the fauna of that region, one of which, dealing with the nemerteans of Puget Sound and describing a number of species new to science, had been sent to

press immediately before his last illness. His principal work lay, however, in the field of cellular biology, and a brief but important paper by him on the fertilization of the egg in *Thalassema*, published in the Transactions of the New York Academy of Sciences for 1895–6, had attracted considerable attention, both in this country and abroad. A more extended paper along the same lines, bringing forward new and important evidence on the nature of fertilization, the history of the centrosome, the phenomena of chromatin-reduction and other vexed problems of cytology was practically ready for the printer at the time of his death and will be hereafter printed. He was a man of singularly pure character. His high ideals of life, his rare and single-hearted devotion to his chosen life-work, will not be forgotten by those who had felt the stimulus of his example.

E. B. W.

CURRENT NOTES ON METEOROLOGY.

THIRST IN THE DESERT.

No more graphic account has ever been written of the physiological effects of the dry air of the desert than that by McGee in the *Atlantic Monthly* for April. The regions to which particular reference is made are those of Death Valley, farther Papagueria (the desert borderland of Arizona and Sonora), and other portions of our western arid country, where "daily for months the air is 120° F. or more in the shade, and dry, so dry that a basin of water evaporates in an hour, so dry that no drop of sweat is shed by hard-pushed horse or toiling pedestrian. * * * * Even the Indians gathered in the moister spots have a shrunken and withered mien, half mummied before death, as they are wholly after. Here thirst abides." The article is grewsome reading, portraying, as it does in the most vivid manner, the five successive stages of thirst in the desert, from the first, in which the symptoms are beginning, to the final stage, in which "there is no alleviation, no relief, until the too persistent heart or lungs show mercy, or kindly coyotes close in to the final feast."

WEATHER CYCLES IN INDIA.

A PAPER by Dallas, in the *Monthly Weather Review* for December, 1897, entitled 'A Preliminary Discussion of Certain Cyclical Changes in India' makes it appear that there are two cycles, both traceable in pressure and rainfall, which affect the weather over the Indian region. One of these cycles runs through a period of 11 years, and the other through a period of 9 years. Both are more distinctly traceable in the records of southern India (Madras) than in the records of the whole of India. It does not, however, appear possible to make use of these facts in predicting, with any certainty, the probable amount of rain in any season with a view to the taking of precautionary measures against impending droughts.

ELECTRICAL STORMS IN CALIFORNIA.

IN the same number of the *Monthly Weather Review* Mr. James A. Barwick, Observer of the Weather Bureau at Sacramento, Cal., discusses 'The Electric Storms of California.' The impression is quite widespread that thunder and lightning are almost unknown in California, but the present paper shows that thunderstorms are by no means infrequent, and that they occur pretty well all over the State. The greatest number come in the hot months of June, July and August, and the storms of these months are confined mostly to the counties of the Coast Range and the Sierra Nevada. The hotter the weather in the summer in California, the greater is the number of thunderstorms, as is found to be the case elsewhere.

BLUE HILL OBSERVATORY BULLETINS.

THE Blue Hill Observatory has begun, with the present year, the issue of a series

of Bulletins, each one containing a brief discussion of some meteorological data of particular interest. So far three Bulletins have been issued, the successive subjects being as follows: No. 1, *The Highest Kite Ascensions in 1897*; No. 2, *Examples of the Diurnal and Cyclonic Changes in Temperature and Relative Humidity at Different Heights in the Free Air*; No. 3, *The Storm of January 31–February 1, 1898*. Each Bulletin is of 4to size, consists of 4 pages, and is illustrated by means of temperature, pressure and other curves.

RECENT PUBLICATIONS.

Anales de la Oficina Meteorologica Argentina. Buenos Aires, 1897. 4to. Pp. 502.

Contains full meteorological tables for the Isla de los Estados (Staten Island), a most interesting station between Lats. 54° and 55° S., off the southeastern extremity of South America.

Weather Forecasting and Weather Types on the North Pacific Slope. B. S. PAGUE and S. M. BLANDFORD. Portland, Ore., 1897. 8vo. Pp. 29. Charts 5.

An excellent pamphlet, along lines which might profitably be followed by other local forecast officials in different parts of the country. We need more study and more illustration of the living weather types that go to make up climate, and rather less time spent on the tabulation of climatic data.

R. DEC. WARD.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

THE HUMAN CRANIAL NORM.

IN the *Correspondenz-blatt* of the German Anthropological Society for December last the distinguished anthropologist, Professor Ranke, has a suggestive article on the individual variations of the skull form, in which he maintains several striking theses.

Thus he argues that the highest cranial form, that of man, is the universal embryonic norm from which the skulls of all the mammalia develop. Again, in following the variations of each individual skull, we find that they represent in turn the cranial forms which have been held characteristic of all the various races of man. Further, every skull at the time of birth is orthognathic, and each has a tendency to become more and more prognathic. This is observable in the highest as well as the lowest races, though in the former it is more frequently checked by anatomical correlations.

KOREAN ETHNOGRAPHY.

Now that the affairs of Korea are served up daily almost in our newspapers, the manners and customs of that country deserve to interest us. One of the most pleasant and yet completest accounts of them was written about a year ago by Professor Edward S. Morse and published in *Appleton's Popular Science Monthly* for May, 1897 (and reprint), under the title 'Korean Interviews.'

In the space of sixteen pages he describes the family relations, education, marriage, customs, religions, burials, usages, festivals, arts, games, etc. The conclusion at which one arrives is that the sooner the present government, laws, customs and religions are wiped out of existence the better it will be for the Korean people, whether this is accomplished by the Russians or the Japanese.

TRIBES ENCOUNTERED BY CORTES.

THE location of the first battlefield of Cortes in the New World, that called 'Cintla,' and the ethic affinities of the tribes he then encountered, have been subjects of varied opinion by M. Charnay, Orozco y Berra and other writers. In an article in the *American Antiquarian* for September, 1896, I attempted to define with precision the geographical spot and the tribe he there encountered. More recently and without a knowledge of my investigations

Don José N. Rovirosa, whose essay on the proper names of Tabasco has made his name known to students, submitted the questions involved to a rigorous examination. It is gratifying to say that in all essential points he reaches conclusions identical with my own, and shows the errors into which M. Charnay was led. Rovirosa's work is entitled 'Ensayo Histórico sobre el Río Grijalva' (Mexico, 1897).

THE CRIMINOLOGY OF MINORS.

THE *Centralblatt für Anthropologie* (Heft I., 1898) has an appreciative notice of a large work by Dr. Ferriani on the criminology of minors. It is based on the records of 2,000 cases and is written in a scientific spirit. Few topics in criminal anthropology merit so close attention as the sources of crime in juvenile offenders. The value of steady employment is shown by the fact that out of the above total 1,112 were idlers. Illegitimate birth, poverty, neglect and evil social surroundings explain the majority of the cases. The prevailing crime was theft, being 1,182 of the whole. Nearly all the males were onanists and the females profligates. The evil influence of criminal association is urgently dwelt upon, and the writer recommends farm colonies under active supervision as the best protection. It is to be hoped that the principal chapters of this book will be translated.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

AMERICAN SUBSCRIPTIONS TO THE SYLVESTER MEMORIAL FUND.

PROFESSOR G. B. HALSTED and Dr. Cyrus Adler announce the receipt of the following subscriptions:

Adler, Dr. Cyrus	$10.00
Bass, Professor E. W.,	10.00
Beman, Professor W. W.,	One guinea
Brown, R. L.,	5.00
Bruce, W. H.,	2.00
Byerly, W. E.,	$5.00
Cohen, Reverend Henry,	2 50
Craig, Professor T.,	10.00
Dutton, C. E.,	5.00
Eddy, Professor H. T.,	One guinea
Frankland, F. W.,	10.00
Franklin, Dr. and Mrs. Fabian,	15.00
Gibbs, Professor W.,	Three guineas
Halsted, Professor G. B.,	50.00
Hathway, Professor A. T.,	3.00
Lewisohn, Leonard,	Twenty pounds
Macfarlane, Dr. A.,	2.00
McMahon, Professor J.,	3.00
Marshall, Louis,	15.00
Merriman, Professor M.,	5.00
Newson, Professor H. B.,	5.00
Pickering, Professor Edward C.,	5.00
Schiff, Jacob H.,	Ten pounds
Snyder, Dr. V.,	2.00
Stern, Louis,	25.00
Wait, Professor L. A.,	10.00
Woodward, Professor R. S.,	20.00
Total, (about)	$394.00

It is desired to close the subscription list by the end of June. Additional subscriptions in America may be sent either to Professor George Bruce Halsted, 2407 Guadalupe Street, Austin, Texas, or to Dr. Cyrus Adler, Smithsonian Institution, Washington, D. C.

A SENATORIAL DOCUMENT ON THE PREVENTION OF CHOLERA.

IN times of national excitement unballasted minds take the opportunity of floating their airy nothings into public notice. When pestilence invades the country all sorts of silly propositions find place in print, or may be formally transmitted for the consideration of the highest officials. We understand that at the present time every mail brings to the departments at Washington, D. C., literary curiosities in the way of advice and offers of service in the event of war. Some of these are dictated purely by patriotism, but many are evidently the offspring of a desire for personal emolument. One communication, which we have seen, explains how the army may, for a consideration, have the benefit of the writer's 'Blood Purifier and Lineament' that our troops may no longer suffer from 'cholera, diarrehe, bloody flux, toothache, scroffalo or cholera infantum.' Such

communications are usually filed for future reference, which means that the file box will become their grave; but one of them, by the persisting energy of its author, has recently attained the status of a senatorial document, No. 111, 2d Session 55th Congress. In this communication, R. B. Leach, M.D., of Minneapolis, Minn., 'prays that a test made of the Arsenization method of treating the disease of Cholera.' No advertising pamphlet ever demonstrated more definitely to the non-medical reader the modus operandi of its eulogized nostrum in neutralizing the foul humors of the human system than this memorial demonstrates how incontrovertible is the theory of the curative and preventive action of arsenic in Asiatic cholera.

The argument of the memorial is based on the principle: *Similia similibus curantur*; but science is slow to accept this principle, and scientific medical practitioners give relief to a sleepless patient by other means than those which will prevent sleep. But the principle being granted, it is shown in the memorial how arsenic produces all the symptoms that characterize an attack of Asiatic cholera from its earliest stage, technically that of invasion, to its latest, that of collapse. It is submitted, in fact, that as belladonna is the similimum of scarlet fever and vaccinia of smallpox, so is arsenic 'the legitimate successor of all anticholeraic inoculations thus far promulgated' and the sure cure and preventive of cholera. Q. E. D.

The memorialist submits that by this drug we may not only 'be protected and finally emancipated from the ravages of Asiatic cholera,' but also be enabled 'to hope for relief from the pernicious theory of inoculations with animal extracts or viruses as now advocated by many ill-advised students of preventive medicine,' as Behring, Roux, Sternberg and other notable men who have been prosecuting with the best lights of modern science the important subjects of causation and immunity. He allows that the work of the bacteriologists is based on a theory as plausible as that of Jenner, but holds that success cannot attend their efforts because they use products of the *same* disease and not of a *similar* disease for tentative immunization, and he claims superiority for arsenic because we are familiar with its potency and antidotes, while those of the germs and toxins are unknown. As showing the memorialist's want of familiarity with this part of his subject, it need only be stated that the word *antitoxin* does not once appear in his argument.

His claim that arsenic for cholera is comparable with belladonna for scarlet fever does not give strength to his position, when we consider that although the alleged prophylactic value of belladonna has been before the world for more than a generation, and although belladonna is to be found in every drug store, the prevalence of scarlet fever has not been materially lessened.

Jenner applied to his theory the experimentum crucis. He vaccinated a child, and proved protection by a subsequent inoculation with smallpox, and since his time this, as far as possible, has been the experimental method of all scientific investigators into the causation and prevention of disease; but the memorial before us urges that on the Q. E. D. aforesaid the government of the United States should undertake the testing of this theory at an estimated expense of $10,000 annually for five years.

It would be almost cruel to the memorialist to close these remarks on his proposition with a suggestion which might raise up a number of imitators and competitors in his particular line, but we must state that arsenic is not the only irritant poison which produces shock, vomiting, purging and collapse. Similar memorials might be drawn up by an intelligent medical student on the action of almost any of the many irritants, such as tartar emetic, corrosive sublimate, croton oil, colocynth, elaterium, colchicum, etc., but we trust there will be no more such puerile documents printed.

REPRINTS OF RARE WORKS ON METEOROLOGY AND TERRESTRIAL MAGNETISM.

To this series, which has been noticed several times in SCIENCE, Dr. Hellmann, of Berlin, has just made two important additions, viz.: No. 10, *Rara Magnetica*, and No. 11, *Ueber Luftelektricität*. The first-named is a fac-simile reproduction of the rarest works on terrestrial magnetism between 1269 and 1599, that is to say,

prior to William Gilbert's epoch-making work, *De Magnete.* The authors quoted are P. de Maricourt, F. Falero, P. Nunes, J. de Castro, G. Hartmann, M. Cortés, G. Mercator, R. Norman, W. Borough and S. Stevin. Explanatory and critical notes in German greatly facilitate their comprehension and appreciation. The typographical reproductions of black letter and MSS. are admirable.

No. 11 is a collection of the fundamental writings on atmospheric electricity between 1746 and 1753. How this branch of science developed from the observations of thunderstorms is told in the papers by J. H. Winkler, B. Franklin, T. F. Dalibard and L. G. Le Monnier, which, reproduced in fac-simile, are also annotated by Dr. Hellmann in his well-known scholarly manner.

A few copies of these reprints are for sale at the Berlin publisher's prices by A. L. Rotch, Director of Blue Hill Observatory, Hyde Park, Mass. The prices, post free, are for No. 10, $3.75, and for No. 11, $1.00.

GENERAL.

THE Maryland Legislature, in addition to passing the regular appropriation of $20,000 for the State Geological Survey, has also appropriated to the same organization $10,000 for topography and $20,000 for the study of the question of road construction in the State. The latter act calls for the investigation of and report upon the character and distribution of the natural road building materials in the several counties and a full statement regarding the present condition of the roads and the best means for their improvement, with estimates of cost of constructing, repairing and maintaining the same. Such universal approval has been accorded by the people and press of the State to the Geological Survey that the acts passed both houses unanimously. The entire appropriation has been placed under the direction of Professor Wm. B. Clark, of Johns Hopkins University, the State Geologist.

PROFESSOR JAMES E. KEELER has accepted the directorship of Lick Observatory. As will be remembered, he consented to stay at the Allegheny Observatory if $200,000 could be collected for a new observatory and its endowment, but this amount was not subscribed within the two weeks allowed. A new Allegheny Observatory is, however, assured, as the subscriptions amount to $150,000.

DR. HENRY T. FERNALD has been appointed to the position of economic zoologist of the State of Pennsylvania. He holds the doctorate of Johns Hopkins University, and is at present professor of zoology in the Pennsylvania State College. Dr. Fernald is a son of the eminent entomologist, Professor C. H. Fernald, of the Massachusetts Agricultural College.

AT the recent annual meeting of the New York Academy of Sciences the following elections as Honorary and Corresponding Members were made: *Honorary*—Professor Arthur Auwers, Astronomer, Berlin; Professor W. K. Brooks, Biologist, Baltimore; Professor David Gill, Astronomer, Cape Town; Dr. George W. Hill, Mathematician, Nyack; Professor E. Ray Lankester, Zoologist, Oxford; Dr. Fridjof Nansen, Explorer, Kristiania; Professor Albrecht Penck, Geographer, Vienna; Professor Wilhelm Pfeffer, Botanist, Leipzig; Professor Hans Reusch, Geologist, Kristiania; Professor Rudolph Virchow, Biologist, Berlin; Professor Karl von Zittel, Paleontologist, Munich. *Corresponding*—Professor F. D. Adams, Geologist, Montreal; Professor I. B. Balfour, Botanist, Edinburgh; Professor George Baur, Paleontologist, Chicago; Professor William Carruthers, Botanist, London; Professor T. C. Chamberlin, Geologist, Chicago; Professor Wm. M. Davis, Geographer, Cambridge; Professor Adrien Franchet, Botanist, Paris; Professor George E. Hale, Astronomer, Chicago; Professor J. P. Iddings, Geologist, Chicago; Professor Charles S. Minot, Biologist, Boston, Professor George Murray, Botanist, London; Professor William B. Scott, Geologist, Princeton; Mr. Charles D. Walcott, Geologist, Washington; Professor Charles O. Whitman, Biologist, Chicago; Professor Henry S. Williams, Paleontologist, New Haven.

THE Berlin Academy of Sciences has elected as Corresponding Members: Professor George Ossian Sars, of Christiania; Professor Adolf Fick, of Würzburg; Professor Carl v. Voit, of Munich; Professor Victor Hensen, of Kiel; Professor

Willy Kühne, of Heidelberg, and Professor Charles Emile Picard, of Paris.

PROVISION is made in the Sundry Civil Appropriation Bill, reported to the Senate for the representation of the United States at the Paris Exposition of 1900, the expenses being limited o $750,000. An immediate appropriation of $200,000 is made. The United States exhibition is to be under the supervision of a Commissioner-General, an Assistant Commissioner-General and twelve experts.

A BILL now before the British House of Commons provides £800,000 for a building for the Science and Art Museum, South Kensington.

WE learn from *Nature* that at the meeting of the Manchester Literary and Philosophical Society on Tuesday the President presented the Wilde medal for 1898 to Sir Joseph Dalton Hooker, G.C.S.I., F.R. S.; the Dalton medal to Dr. Edward Schunck, F.R.S., and the Wilde premium for 1898 to Mr. John Butterworth. The Wilde lecture, 'On the Physical Basis of Psychical Events,' was afterwards delivered by Professor Michael Foster.

As we go to press the New York Academy of Sciences is holding its fifth annual reception and exhibition in the American Museum of Natural History. We hope to give an account of the exhibits and to publish the lecture before the Academy given by Professor Hale, Director of the Yerkes Observatory.

DURING the month of March the Academy of Natural Sciences of Philadelphia received several gifts, including a valuable collection of lichens from Dr. John W. Eckfeldt, a collection of fossil molluscs from Jamaica, by Mr. S. Schumo, and a collection of butterflies and moths from Honduras by Dr. H. Griffith.

PRINCETON UNIVERSITY has received from Mr. J. B. Hatcher a collection of fossil shells from the Straits of Magellan, and other collections have been forwarded. At the time of the writing of the last letter the party expected to start on March 1st for an eight months' trip into the interior of Patagonia.

PROFESSOR A. E. VERRILL, of Yale University, and a party of students have gone to the Bermuda Islands to study the coral formations and to collect specimens which will be deposited in the Peabody Museum.

DR. H. A. CUPPY, Director of the University of Chicago Press, states in *Printer's Ink* that the *Botanical Gazette*, the *Journal of Geology* and the *Astrophysical Journal* have each an issue of 1,000 copies.

THE Academy of Sciences of Naples offers a prize of 500 francs for an essay on stereochemistry. The time limit is June 30, 1899, and the language English, Italian or French.

THE Société des Secours des Amis des Sciences of Paris held its annual meeting at the Sorbonne on April 2d, M. Joseph Bertrand presiding. M. E. A. Martel made an address on the caves of Europe.

THE annual exhibition of the German Agricultural Society will be held this year from June 16th to 21st, at Dresden. Foreigners will be admitted to compete in the sections of agricultural machinery and implements, and of fertilizers and feeding stuffs, but the section of animals will be restricted to exhibits bred in Germany. Applications for the programs of the exhibition should be addressed to Das Direktorium, Deutsche Landwirtschafts-Gesellschaft, Berlin, S. W., Kochstrasse, 73.

THE International Aeronautical Committee appointed at the Paris Meteorological Congress of 1896, met at Strasburg on March 31st. The program included a discussion of the four first international balloon ascensions, plans for future ascensions and a discussion of the use of kites and balloons for meteorological purposes. The last discussion was opened by Dr. A. Lawrence Rotch. The conference met under the presidency of Dr. Hergesell, Director of the Meteorological Bureau of Alsace-Lorraine, and there were about forty men of science present from France, Austria, Russia, Germany and America.

AT the instance of the Prince of Monaco, Captain Chares, a Portuguese man of science, has established two meteorological stations on the Azores—one on the island of San Miguel, which is connected with the main land by cable, and one on the island of Flores, one hundred miles farther to the west, from which a cable to America is planned. It is expected that the

observations will be of value, especially with regard to the course of cyclones.

M. Antoine Varicle, of the French Geographical Society, has arrived in New York with a balloon with which he intends to make the trip from Juneau to the Klondike. According to the New York *Evening Post* the balloon is cylinder-shaped, has a sail beneath it, and is equipped with electric lights and a searchlight. The expedition carries with it all the modern instruments of geographical and topographical science. Carrier-pigeons will be employed to send back news of the progress of the expedition. The balloon will carry about 7,300 pounds. A feature of it is an 'automatic ballasting apparatus,' which is said to enable the aeronaut to direct the balloon to a certain degree. Photographs will be taken from the balloon en route. The cost of the expedition is borne partly by the French Geographical Society and partly by the members of the party.

Captain John Bartlett, who will command the Arctic steamer *Windward* in the Peary Polar expedition this summer, has left St. John's for New York to perfect arrangements for the cruise. The *Windward* will sail from New York about the first week in July.

Cases of the plague are occurring in increasing numbers at Jiddah, and it is feared that the epidemic may reach Mecca and be introduced into Europe by returning pilgrims.

The *British Medical Journal* for March 19th contains an article by Dr. L. Sambon on sunstroke, which he calls siriasis, that is likely to attract attention. He contends that the disease is an infection produced by a specific germ belonging to the same category as that of yellow fever.

Dr. G. S. Buchanan, in his report to the British Local Government Board upon the recent cases of enteric fever in Essex and Suffolk suspected to have been caused by eating Brightlingsea oysters, formulates the following conclusions: (1) That in every instance the attack was due to the ingestion of infected oysters; (2) that in 25 out of the 26 cases investigated the implicated oysters could be traced almost with certainty to layings in Brightlingsea Creek; (3) that, though in five of these cases the particular Brightlingsea laying or layings which had furnished the implicated oysters could not be ascertained, the facts as regards the remaining 20 cases were sufficient to warrant inference that the implicated oysters had been taken, prior to their delivery to their respective vendors, from one or other of two particular layings in Brightlingsea Creek; (4) that the two layings thus implicated formed part of an oyster beach situated on the foreshore of Brightlingsea Creek, close to the outfalls of the three main sewers of the town of Brightlingsea, a foreshore which is conspicuously exposed to pollution by sewage; and (5) that at sundry different periods in the course of 1897 infectious matter derived from persons suffering from enteric fever at Brightlingsea must needs have been discharged from the Brightlingsea sewer outfalls.

Another important addition has been made to our knowledge of the retina by Ramon y Cajal. He has made out that the cones are to be considered from the histogenetic standpoint as a more highly developed form of the rods. This works to the favor of those theories of the sensation of light which regard the color-sense of the cones as being the result of a gradual development out of the achromatic sensation furnished by the rods. According to some observers, the cones in the periphery of the retina resemble the rods very much in appearance; if it could be made out that in the dichromatic retinal zone (the zone in which reds and greens are not perceived) there is an intermediate form of cone (a form with only a few basilar threads, for instance), that would also be a fact of much theoretical interest. The histologists would do well to investigate the question with more care than has yet been done, and with modern methods.

The alleged invention of Szczepanik has occupied much space in the daily papers and it may be well to quote here the comment made by Professor Sylvanus P. Thompson in an English journal: "If Herr Szczepanik has really accomplished anything, why does not his agent tell us what he has done, instead of giving long disquisitions as to how he intends to do it? The entire description of the process is quite compatible with the achievement of nothing in the

way of results. There is nothing new in the suggestion to transmit pictures electrically by breaking them up into lines or dots, or to reflect the rays upon selenium cells, or to move prisms by electro-magnets. The sole and only point of any importance is: Has Herr Szczepanik yet got any real results? The complicated mechanical contrivances suggested cannot be made to work as rapidly as is necessary without some most amazing skill in construction. A process block looks spotty unless its line-structure is much finer than the fineness of 100 lines to the inch, or, in other words, unless the square inch contains 10,000 points. Now as the duration of luminous impressions on the eye to give continuity is of the order of only one-twelfth of a second (kinematograph views are bad unless more than twelve pictures a second are made to succeed one another), it follows that to transmit pictures only one square inch in area will require that the whole of these 10,000 points shall be successively imaged within about one-twelfth of a second. Now, there is no known electric mechanism which will oscillate a mirror or prism with precision at a frequency of 120,000 a second, even though the electric line is only a few yards long. To talk of doing this through a line a thousand miles long is, in the present state of mechanical and electrical knowledge, sheer nonsense. To make crude and wild suggestions is very easy. To take out patents for crude suggestions is quite feasible. To get newspaper articles describing them as facts is still easier. I will only repeat: What has Herr Szczepanik done? Why conceal the fact—if fact there be—in a maze of verbiage?"

AT the Lehigh University Dr. Macfarlane has just finished a course of six lectures on the 'Algebra of the Complex Quantity and its application to Alternating Currents.' He considered the principles which apply to the circular complex quantity, the hyperbolic complex quantity, and a complex quantity which is composed of the circular and hyperbolic. All the ideas were defined geometrically and the application of each theorem to alternating currents was pointed out.

THE United States Senate has passed unanimously the bill appropriating $350,000 for the exposition of American manufactured goods suitable for export, to be held in Philadelphia next year under the auspices of the Philadelphia Museums and the Franklin Institute. The bill carries an appropriation of $50,000 "for the collection, in foreign markets, of samples of merchandise of the character in favor and demand therein, and of illustrating the manner in which merchandise for such markets should be prepared and packed, together with necessary data concerning the samples to be displayed at the Exposition for the instruction and benefit of American manufacturers and merchants, and thereby laying the foundation of a great system of national commercial education." The samples of merchandise are to become the property of the Philadelphia Museums. To aid in providing buildings necessary for the purposes of the Exposition, the buildings to be erected on the land set aside by the city for the permanent buildings of the Museums, and after the close of the Exposition to be available for the purposes of the Museums, the sum of $300,000 is appropriated. Out of such sum is to be paid the expenses of collecting and installing such an exhibit by the United States government as may be found expedient and desirable. It is provided that this appropriation shall not become available until subscriptions, donations or appropriations for the purposes of the Exposition, aggregating at least $300,000, shall be obtained by the Museum and Exposition Association.

THE Imperial Statistical Office has, according to the *Lancet*, recently published the returns of the causes of death in the towns of Germany of more than 15,000 inhabitants from the year 1885 to the year 1895. These returns show that from 1885 to 1894 there were 119,038 deaths from diphtheria or croup, the average number thus being 11,904 per annum. The maximum was reached in 1892 by 15,860 deaths and the minimum in 1888 by 9,934 deaths. In 1895, when diphtheria antitoxin was first used on a considerable scale, the deaths went down to 7,266. The diphtheria death-rate was 10.69 per 10,000 of the population in the preceding ten years and only 5.4 in 1895, so that the mortality had fallen 49.48 per cent. Of 100 deaths 4.53 were caused by diphtheria from 1885 to

1894 and and only 2.53 in 1895. The decrease of the death-rate from diphtheria was almost uniform in every district of the Empire; the prevalence of the disease was, however, about the same as it had been for the last twenty years, and the *Lancet* holds that is unquestionable that the serum treatment has had the effect of producing a remarkable improvement.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. HENRY STAFFORD LITTLE, of Trenton, N. J., has given $100,000 to Princeton University to complete the quadrangle in the campus by the erection of a new dormitory.

MISS GOULD has given $20,000 to the endowment fund of Rutgers College.

RUSH MEDICAL COLLEGE, Chicago, has been freed of its debt of $71,000, and will now be affiliated with the University of Chicago, adding a faculty of seventy-seven members and seven hundred students.

THE Trustees of Cornell University have voted $45,000 for an addition to Morse Hall Chemical Laboratory of the University. The first floor of the new building will be devoted chiefly to inorganic chemistry, while the second floor will be for physical chemistry.

CHAIRS of physiology and and anthropology and anatomy will be established in the University of St. Andrew's, Scotland.

DR. KARL CHUN, professor of zoology at Breslau, has been called to Leipzig as successor to the late Professor Leuckart.

DR. G. BORN has been appointed full professor of anatomy in the University of Breslau; Dr. A. L. Bolk, professor of anatomy in the University of Amsterdam; Dr. P. Malerla, professor of physiological chemistry in the University at Naples; Dr. Gottloeb, professor of pharmacology in the University at Heidelberg, and Dr. Warburg, professor of botany in the University of Berlin.

THE following appointments for fellowships in the sciences have been made by the Board of Trustees in the University of Chicago: H. N. Stuart, Philosophy; M. L. Ashley, Philosophy; H. C. Biddle, Chemistry; A. W. Dunn, Anthropology; H. G. Gale, Physics; H. E. Goldberg, Chemistry; W. McCracken, Chemistry; M. D. Slimmer, Chemistry; Helen B. Thompson, Philosophy; C. E. Siebenthal, Geology; H. H. Newmann, Zoology; H. E. Davis, Zoology; W. N. Logan, Geology; H. Lloyd, Mathematics; Amy Hewes, Sociology; R. G. Kimble, Sociology; R. S. Lillie, Zoology; C. E. Rood, Astronomy; M. F. Guyer, Zoology; D. N. Lehmer, Mathematics; C. Ellwood, Sociology; J. W. Finch, Geology; I. Hardesty, Neurology. H. H. Bawden, Philosophy; Caroline L. Ransom, Archæology; F. L. Stevens, Botany; Elizabeth R. Laird, Physics; R. George, Geology; J. H. McDonald, Mathematics; W. R. Smith, Botany; Emily R. Gregory, Zoology; R. H. Hough, Physics; D. T. Wilson, Astronomy; S. F. Acree, Chemistry; F. Reichmann, Physics; F. E. Bolton, Pedagogy; E. H. Comstock, Mathematics; G. A. Sikes, Sociology.

DISCUSSION AND CORRESPONDENCE.

ASTRONOMICAL RESEARCH AND TEACHING.

TO THE EDITOR OF SCIENCE: It is a well known fact that many promising students, who have shown exceptional aptitude for original investigation during their university career, and, perhaps, have made important contributions to science in their published works, are never again heard from after obtaining college positions. In too many cases this is due to the fact that they are required to devote all their energies to the work of instruction, sometimes not in one subject only, but in several widely separated departments of study. The spirit of research, which may have been strong and vigorous when stimulated by the wholesome atmosphere of university life, rapidly fades away in such environment, and with it disappears all desire to make further contributions to knowledge.

As what has been said applies with special force to students of astronomy, it was felt by certain members of the Astronomical Conference, held at the Yerkes Observatory in October last, that a general expression of opinion on this important subject was desirable. It was seen, on the one hand, that the severe demands

of astronomical observation and investigation were sometimes not duly appreciated by the trustees and committees supervising educational institutions, and that thus the very purpose for which these observatories existed had, in a number of cases, been thwarted; and, on the other hand, that these observatories, failing to be actively administered, had ceased to be a force in teaching astronomical science.

These conditions were deemed important enough to require the serious attention of the Conference, but, unfortunately, by the time the subject had been sufficiently discussed the meetings were drawing to a close, and the following preamble and resolution, which one of the members expected to present to the Conference, could not formally be laid before it. In lieu thereof the signatures appended were obtained by the framer of the resolution in order that the professional opinion of active astronomers might still be recorded, and thus the managers of educational institutions having observatories might have a fair basis for remedying a very unfortunate condition.

The matter having been left in my hands, I have deemed it desirable to publish the preamble and resolution in Science, so as to meet the educational and scientific purposes for which they were drawn and signed by members of the Conference.

George E. Hale.

"Whereas, at a number of astronomical observatories connected with American institutions of learning the Director of the observatory is obliged, in addition to his work of observing by night and experimenting and making long and intricate computations by day, to devote an unreasonable amount of time to class-room teaching; and, whereas, this lack of consideration for the arduous work of the practical astronomer is alike detrimental to science and injurious to the highest grade of teaching properly associated with an observatory.

"Therefore, be it resolved by this conference of astronomers, that it is the unanimous and deliberate opinion of this body that the practical astronomer in charge of an observatory and carrying on both observatory work and teaching should not be required to teach classes oftener than five hours per week, and should besides be given the greatest freedom in arranging his entire scientific work associated with the observatory."

Approved by the undersigned.

Signed:

S. Newcomb,
Former Director of the Nautical Almanac Office, Washington, D. C.

Edward C. Pickering,
Director of the Harvard College Observatory, Cambridge, Mass.

J. M. VanVleck,
Professor of Mathematics and Astronomy, Wesleyan University, Middletown, Conn.

Wm. Harkness.
Director of the United States Naval Observatory and Nautical Almanac, Washington, D. C.

George E. Hale,
Director of the Yerkes Observatory, University of Chicago, Williams Bay, Wis.

James E. Keeler,
Director of the Allegheny Observatory, Allegheny, Pa.

M. B. Snyder,
Director of the Philadelphia Observatory, Philadelphia, Pa.

H. S. Pritchett,
Superintendent of the United States Coast and Geodetic Survey, Washington, D. C.

H. C. Lord,
Director of the McMillin Observatory, Columbus, Ohio.

Frank W. Very,
Formerly of Allegheny Observatory, now of Providence, R. I.

Milton Updegraff,
Director of the Law's Observatory, Columbia, Mo.

John G. Hagen, S. J.
Director of the Georgetown College Observatory, Washington, D. C.

Charles Lane Poor,
Associate Professor of Astronomy, Johns Hopkins University, Baltimore, Md.

A. S. Flint,
Assistant Astronomer, Washburn Observatory, Madison, Wis.

WM. R. BROOKS,
Director of Smith Observatory, Geneva, N. Y.

E. E. BARNARD,
Astronomer, Yerkes Observatory, Williams Bay, Wis.

G. W. MEYERS,
Director of Observatory, University of Illinois, Urbana, Ill.

HENRY M. PAUL,
Astronomer, United States Naval Observatory, Washington, D. C.

WM. W. PAYNE,
Director of Carleton College Observatory, Northfield, Minn.

J. K. REES,
Director of Columbia College Observatory, New York City.

S. W. BURNHAM,
Astronomer, Yerkes Observatory, Williams Bay, Wis.

C. L. DOOLITTLE,
Director of the Flower Observatory, University of Pennsylvania, Philadelphia.

F. L. O. WADSWORTH,
Astrophysicist, Yerkes Observatory, Williams Bay, Wis.

DAVID P. TODD,
Director of the Observatory, Amherst College.

MRS. PIPER, THE MEDIUM.

THE last number of the *Proceedings of the Society for Psychical Research* contains a statement to the effect that the present writer does not pay 'the slightest attention to psychical research *à la* English Society;' he 'taboos it throughout, but has never even read the reports and their experiments in telepathy.' If this information were obtained by telepathy it does not increase my confidence in that method of communication. It is exactly the thirteen volumes issued by the Society for Psychical Research that seem to me to prove the trivial character of the evidence for the heterogeneous mass of material taken under the wing of the Society.

The present number of the *Proceedings* seems to me, however, of some interest in that it concludes or continues an account of the séances of Mrs. Piper, under the title, 'A Further Record of Observations of Certain Phenomena of Trance,' on which subject Dr. Richard Hodgson has now contributed over 600 pages. The case of Mrs. Piper is of interest, because Professor James has said:

"If you wish to upset the law that all crows are black, you musn't seek to show that no crows are; it is enough if you prove one single crow to be white. My own white crow is Mrs. Piper. In the trances of this medium, I cannot resist the conviction that knowledge appears which she has never gained by the ordinary waking use of her eyes and ears and wits." (SCIENCE, N. S., III., 884.)

It is Professor James who gives dignity and authority to psychical research in America, and if he has selected a crucial case it deserves consideration. The difficulty has been that proving innumerable mediums to be frauds does not disprove the possibility (though it greatly reduces the likelihood) of one medium being genuine. But here we have the 'white crow' selected by Professor James from all the piebald crows exhibited by the Society.

I find, among the great number of names and initials whose séances with Mrs. Piper are reported, five and only five well-known men of science. The following are the concluding sentences of their reports:

These elements of truth were, however, so buried in masses of incoherent matter and positive errors as to matters in which she tried to give information that the sense of her failure on the whole is far stronger with me.

Even as to the fact of her being in a trance at all my impression is not strong, despite the fact that I came fully expecting to be convinced on that point.

My state of mind, therefore, is almost the same that it was before the sitting, *i. e.*, a condition of willing approach to any evidence on either side of the question at issue; I am only disappointed that she did not give me more data for forming a positive opinion. I am fully aware, however, that one such sitting has very little negative weight, considering the variations which this sort of phenomena are subject to.

J. MARK BALDWIN.

I was struck by a sort of insane cunning in the groping of the woman after something intangible.

It did not seem to me that she simulated a trance state. She was apparently, as far as I could judge, in some abnormal condition.

I could not discover that she hit upon anything that was connected with the handkerchief.

JOHN TROWBRIDGE.

Let me say that I have no firm mind about the matter. I am curiously and yet absolutely uninterested in it for the reason that I don't see how I can exclude the hypothesis of fraud, and, until that can be excluded, no advance can be made.

When I took the medium's hand, I had my usual experience with them, a few preposterous compliments concerning the clearness of my understanding, and nothing more.

N. S. SHALER.

Since writing the foregoing, I have gone over the notes in detail, making a memorandum of successes and failures. I am surprised to see how little is true. Nearly every approach to truth is at once vitiated by erroneous additions or developments.

J. M. PEIRCE.

On re-reading your notes I find absolutely nothing of value. None of the incidents are correct, and none of the very vague things hinted at are true, nor have they any kind or sort of relation to my life, nor is there one name correctly given.

S. WEIR MITCHELL.

Truly, "we have piped unto you, but ye have not danced."

J. McK. C.

SCIENTIFIC LITERATURE.

A Text-Book of Zoology. By T. JEFFERY PARKER, D.Sc., F.R.S., Professor of Biology in the University of Otago, Dunedin, N. Z., and WILLIAM A. HASWELL, M.A., D.Sc., F.R.S., Professor of Biology in the University of Sydney, N. S. W. London, Macmillan & Co.; New York, The Macmillan Co. 1897. 8vo. Pp. xxxv + 779 (Vol. I.) + xx + 683 (Vol. II.). Price, $10.50.

Parker and Haswell's long awaited text-book will be welcomed with pleasure and even with gratitude that so admirable a work has been placed within the reach of teachers and students of zoology, but we cannot repress a feeling of sadness that its gifted senior author did not live to see the fruit of the immense labor that he must have bestowed upon it. It was to be expected that the author of the 'Elementary Biology' and of the 'Zootomy' would produce a work on zoology of high merit. This expectation has not been disappointed and Professors Parker and Haswell have given us a book which is sure to take and long continue to hold a leading place among manuals of zoology.

The book shows throughout the influence of Parker's long experience as student, teacher and author, in the teaching of elementary biology by the method usually associated with the name of Huxley, whose demonstrator he was between the years 1872 and 1880. Huxley's method was distinguished especially by the prominence given to the 'type' system, by the stress laid upon physiological and morphological considerations as opposed to the *minutiæ* of botanical and zoological classification, and by the effort to treat plants and animals, as far as possible, as only two aspects of one fundamental series of phenomena. It has often been criticised —sometimes justly, sometimes through a misconception of Huxley's theory of biological teaching or a lack of acquaintance with the conditions of its practical application; it has been variously modified to meet special needs and conditions, but there can be no question as to the great stimulus that it gave to biological studies or the vast improvement it has effected in the teaching of botany and zoology in the strict sense.

The precise relation of elementary biology to the subsequent study of zoology or botany has not thus far found very definite expression in the text-books. Parker and Haswell's book is so arranged as to follow naturally after such an elementary course, but despite its bulk it is also skilfully adapted to the needs of the beginner who has not had the advantage of the preparatory work. The book takes its point of departure from a brief account of *Amœba*, which is prefaced to a general introductory study of animal cells, tissues and organs and some of the more important facts of animal physiology. This introduction has wisely been made as brief as possible, and the principal discussion of general questions has been deferred to the end of the book, where will be found excellent chapters on distribution, the 'philosophy' and history of zoology, heredity, evolution and the like. In the systematic treatment of the groups, forming the main body of the book, the type system is consistently followed throughout. While fully aware of the limitations and drawbacks of

that system, the authors recognize the fact that it is, as a rule, impracticable to pursue the academical study of zoology on the broader lines of natural history, and that students must in general acquire their training through the accurate and thorough study of a comparatively small number of forms in the laboratory. Each group (the class, as a rule) is accordingly introduced by the thorough examination of a single representative or 'example,' and the treatment is such as to render the book as useful on the laboratory table as in the study. From the study of the 'example' the student is led to a brief account of the distinctive characters and classification of the class, the systematic position of the example, and finally to a more extended comparative discussion of the general organization, development and affinities of the group as a whole. We think the book would have been much more useful had the authors followed the example of Claus in giving some of the more important families under the leading orders, and by the use of smaller type this might have been done without material increase in size. The authors have shown good judgment in not confining the descriptive part too closely to anatomical detail, having added, wherever possible, accounts of embryological development and larval metamorphoses, with something also of habits, life-history and distribution. The book is thus much increased in effectiveness and is relieved in a measure of the dryness that has often characterized zoological text-books.

To criticise so bulky a work in detail would hardly be possible within the limits of this review.* The classification adopted will probably be in its main outlines sufficiently acceptable to most morphologists, though some of its details are open to serious criticism. We are glad to see the Porifera recognized as a phylum distinct from the Cœlenterata, the Scyphoza separated from both the Hydrozoa and the Actinozoa, and the unspeakable 'Vermes' consigned to a limbo from which it is to be hoped they will never emerge. On the other hand, the phylum Arthropoda is retained with hardly an intimation of the opposing view, held by a considerable number of morphologists, that this group falls into at least two distinct phyla. The retention of the group 'Gephrea' in the old sense seems little short of a blunder; for it is generally admitted that the Sipunculacea are but remotely connected with the Echiuroids, the latter being degenerate annelids, while the former have wholly distinct affinities. We think that many morphologists will be disposed to question the desirability of retaining *Amphioxus* among the 'Vertebrata;' for, although the discovery of the nephridia and other recent investigations clearly indicate its affinities to the higher chordates, it may well be doubted whether the gap between *Amphioxus* and the tunicates is any greater than that which still separates it from the lowest craniate.

* For a number of detailed criticisms pointing out some important errors, see a review in *Natural Science* for March, 1898, which has appeared since the present review was written.

The above are, however, minor criticisms. A real and very obvious defect lies in the order of treatment of the invertebrata. If the study of morphology has shown anything regarding the complicated relationships of the invertebrate phyla, it has shown that the 'Molluscoida' and Echinodermata are but remotely connected, either in structure or in development, with the rotifers, annelids and mollusks, while all three of these groups show well-marked, if not direct, affinities to the Plyathelminthes. The authors recognize the near relationship of the rotifers to the annelids and mollusks by introducing the former group with a description of the annelid trochophore (I., p. 298); and this affinity is again recognized in a genealogical tree nearly two hundred pages farther on (p. 483). Yet the Trochelminthes are separated from the Annulata by the Molluscoida and Echinodermata, producing a breach of continuity which can be only misleading and confusing to the student. It would seem from every point of view preferable to place the latter two groups after the Annulata, Arthropoda and Mollusca at the end of the first volume—an arrangement which would allow a nearly continuous treatment from the Platyhelminthes up to these groups, and at the same time give opportunity for more direct discussion of the possible affinities of the echinoderms and some of the 'molluscoids' to the lower Chordata. Fortunately, such a transposition can readily be

effected in practice; it is, indeed, one of the merits of the book that it is capable of a considerable degree of modification in actual use to adapt it to different conditions of instruction or to differences of view regarding classification.

On the whole, the new text-book deserves a warm welcome, and while not sufficiently extended to take the place of some of the larger manuals, such, for example, as Lang's fine treatise on comparative anatomy, we believe it will be found an invaluable aid not only to special students of zoology, but also to a large number of those whose main interest lies in other branches of scientific study. Written with a clearness, accuracy and method that bespeak the practiced teacher, it is admirably illustrated with a profusion of figures—there are nearly twelve hundred in all—of the highest excellence. A large proportion of these are original; they are often of an artistic merit rarely attained in text-books; they are almost without exception clear, yet are rarely schematized. In all these respects the book offers a model which cannot be too highly praised.

E. B. W.

Traité de zoologie, publié sous la direction de Raphaël Blanchard. XVI., Mollusques, par PAUL PELSENEER; XI., Némertiens, par LOUIS JOUBIN. Paris, Rueff et Cie. 1897. 8vo. Illustrated. Pp. 187 and 59.

The present work comprises 24 pages of general introduction, followed by chapters on the five molluscan classes adopted, two pages on phylogeny and an appendix of two pages on the problematical *Rhodope*, which the author regards as forming a subdivision of the Flatworms. Each chapter comprises a general discussion of the anatomy taken up by successive groups of organs, followed by a synopsis of the development, habits and classification.

The work consists chiefly of a rearrangement, with some additions, of the material in the author's 'Introduction à l'étude des mollusques,' published in 1892 in the Annales de la Société Royale Malacologique de Belgique.* Like that work, it contains a useful compilation of the principal data on the anatomy and development of mollusks, more or less biased, as to inclusions and omissions, by the author's personal views in regard to sundry contested topics. While all the advances of the last six or eight years may not be chronicled, the general discussion contains for the gastropods and amphineura a fairly complete summary of current opinion relating to the recent members of these groups. In the case of the Pelecypods the author adheres to the views introduced by him some years ago, and omits to mention the facts which have been put on record since that time, which, to say the least, have rendered his speculations decidedly less probable than they at first appeared to be. The treatment of the Cephalopods, from the ignoring of data furnished by paleontology, is the least complete of all.

*Tome VII., quatr. sér., pp. 31–243.

In the matter of classification the work is hardly up to the level of criticism, and would have gained in strength and dignity if the feeble and unequal attempts at systematic arrangement had been entirely omitted. Of the most important advances in the systematic study of mollusks during the last few years, such as Pilsbry's work on the *Pulmonata* and Chitons, Hyatt's contributions to the developmental knowledge of extinct Cephalopods, or Bernard's researches on the development of the hinge in bivalves, this treatise contains not the slightest trace. On the other hand, the useful work of indicating to the student the lines on which research is most needed, or likely to prove fruitful, has not been attempted. The illustrations are clear and good, though most of them are familiar. It can hardly be claimed that the occasional dabs of color add much to their value.

Joubin's work on the Nemerteans seems to be a satisfactory and well written summary of our knowledge of this interesting group. The illustrations are particularly good, and the author's style is attractively clear. He accepts the classification of Bürger as on the whole the most precise and natural. The paper concludes with an interesting discussion of the relations of the group to other worms, in which the conclusion is reached that they are very closely allied to the Turbellarians, with which (including the Cestodes and Trematodes) they constitute the order of Plathelminthes.

W. H. DALL.

Botanical Observations on the Azores. By WILLIAM TRELEASE. 8th Annual Report, Missouri Botanical Garden, 1897.

The title of this work, and the appearance of its pages—crowded with names and bibliographical references—do not suggest anything of general interest. Nevertheless there is perhaps more to attract the general naturalist than the specialist in botany, on closer examination; for while the new species and varieties are few and mostly of minor interest, the list of the flora—complete to date—forms a valuable contribution to our knowledge of plant distribution.

Dr. A. R. Wallace, in *Island Life* (2d Ed., 1892), has given us an excellent summary of what is known about the natural history of the Azores, showing that they are truly oceanic islands, but that the number of endemic forms is comparatively small. There is one peculiar bird—a bullfinch; there are fourteen peculiar beetles, including two peculiar genera of weevils; of the sixty-nine land shells, as many as thirty-two are said to be peculiar; of the flowering plants, Dr. Wallace, following Mr. H. C. Watson, cites 40 as endemic; Dr. Trelease reduces these to 36, and not all of this smaller number are as distinct as might be wished. The genera containing the endemic plants are as follows:

PHANEROGAMS: *Cardamine, Cerastium, Hypericum, ViciaRubus, Sanicula, Ammi* (*3*), *Chærophyllum, Scabiosa, Bellis, Tolpis, Picris* (*2*), *Lactuca, Campanula, Vaccinium, Erica, Lysimachia, Myosotis* (*2*), *Veronica, Euphrasia, Persea, Euphorbia* (*2*), *Habenaria* (*2*), *Luzula, Carex* (*2*), *Holcus, Deschampsia, Festuca, Juniperus.*

PTERIDOPHYTES: a *Selaginella* and an *Isoëtes*; no endemic ferns.

MUSCI: *Sciaromium, Astrodontium, Bryum, Breutelia, Glyphomitrium, Hypophila, Campylopus* (*2*), *Sphagnum* (*3*).

ALGÆ: *Bryopsis.* LICHENES: *Lecidia.*

Dr. Trelease remarks: "More evidently than is the case with the Canary Islands, the endemic flora of the Azores appears to be undergoing a gradual reduction, partly because of the utilization of all available land for agricultural purposes. In some of the islands even the high-lying pasture lands are being restocked with foreign plants from the European and American continents, in the belief that they are more valuable than those native to the islands; but, as a rule, such changes as are taking place above the zone of cultivation are fought out on the lines of the survival of the fittest." Again he remarks: "It is observable that a large percentage of the species referred to on Mr. Watson's authority only have not been detected since the days of his own collecting and that of Mr. Hunt, a half century ago."

This rapid change, due to the direct and indirect influence of man, has doubtless already obliterated much of the native fauna and flora. But, as Wallace shows, the islands must in past times have been exposed in a lesser degree to invasions of foreign organisms, and each species which established itself must have disturbed the existing balance. It is said that scarcely a storm occurs in spring or autumn without bringing one or more species of birds foreign to the islands, and it is not necessary to point out how these numerous stragglers must have brought seeds from time to time.

Nevertheless the islands contain some remnants of an ancient fauna and flora, and the proportion of endemic forms, as seen from the above data, differs in the different groups. Following the train of thought suggested by Wallace, we may probably establish the following law: *The percentage of endemic forms in any group in the Azores is approximately in inverse ratio to the facilities that group has for reaching the islands from elsewhere.* In other words, those groups which show very ancient members are precisely those which have least been disturbed by competitors from without.

It is, from this point of view, easy to understand why the land mollusca show so many endemic types, including a slug (*Plutonia atlantica*) belonging not only to a peculiar genus, but a peculiar subfamily. On the other hand, we see why there is only one endemic bird, and that not very distinct. Applying the same rule to the flowering plants, it seems that the endemic species belong on the whole to genera which would not be very easily introduced by birds or by the wind. This, however, is a matter which needs to be critically examined by a botanist, and it would be especially interesting to know how well the seeds of the genera con-

cerned withstand vicissitudes, as of warmth or moisture. It is to be observed that in *Cardamine*, *Sanicula*, *Ammi*, *Chærophyllum*, *Bellis*, *Lactuca*, *Vaccinium*, *Erica*, *Lysimachia*, etc., there are either no species but the endemic ones, or the other species are rare or local—probably usually of recent introduction.

We are naturally led to ask why the ancient fauna and flora, which must have been composed of a fair number of species, was so little able to acquire or preserve distinctive characters, when such islands as the Caymans in the West Indies, only a short distance from land, have many peculiar species, even of birds. One of the endemic beetles has its nearest ally in Madagascar, while one of the mosses is declared by M. Cardot to be *Philonotis obtusata*, described from Madagascar. These and other indications suggest that the population of the islands included, at least in part, forms which were not able to withstand the competition of westward-migrating types upon the continents, and which were liable to be driven out from their last stronghold on the islands by those same types as soon as they appeared upon the scene. It is probable that long isolated forms might lose the power of resisting disease or evading enemies, so that when these reached the islands continental types introduced at about the same time would have the advantage. Still again, if the islands have undergone changes of level and consequently of area, the competition must at times have become very severe, leading to the extinction of many species when the area was reduced; while an increased area would afford exceptional facilities for the immigrants.

T. D. A. COCKERELL.

MESILLA PARK, N. M., February 23, 1898.

The Antiquities of Tennessee and the Adjacent States. By YATES P. THRUSTON. Cincinnati, The Robert Clarke Co. 1897. Second Edition. Illustrated. Pp. 369.

It is only by a considerable stretch of bibliographic courtesy that this can be called a second edition of Mr. Thruston's book. It is, in fact, the signatures of the first edition, to which some pages, distinguished by letters, have been added, and two new plates. The index does not include the additional material. As a treatise on the specimens of aboriginal art discovered in the area of the State, this volume must be preferred to others. The author has endeavored to verify the finds and to avoid the dangers of deception from 'fakes.' He is right in his conclusion that the remains reveal a condition of culture higher than that which obtained among the resident tribes at the period of the discovery.

D. G. BRINTON.

Beiträge zur Völkerkunde der Deutschen Schutzgebiete. By FELIX VON LUSCHAN. Berlin, Dietrich Reimer. 1897. Mit 46 Tafeln und 48 Text Abbildungen. Folio. Pp. 87.

In this handsomely published volume Dr. von Luschan presents a mass of interesting material relating to various African tribes, notably the Massai, Swaheli, Togo, Cameruns, and also the New Britains. The earlier portions are devoted to physical anthropology, the measurements having been made in accordance with a very complete scheme which is detailed on page 6. Among the subjects may be noted two female dwarfs, in size about that of a nine-year-old child, but in functions, developed women. They apparently belonged to some of the interior pygmy races. The numerous accurate photographs which accompany these measurements add to their interest.

The ethnographic material represents a variety of articles of native manufacture. Among the decorations is a well marked 'svastika,' from the Togo district, undoubtedly locally developed there, and which is clearly traceable to a conventionalized lizard (p. 46). Such examples should suggest caution to those writers who are wont to make so much of this common figure.

Another object (described and depicted, pp. 65, 66) is the 'throwing-stick.' It is common in New Holland and in various parts of Oceanica, and, as is well known, recurs in several areas of North and South America. Mortillet has pointed out that it was familiar to the men of the 'reindeer period' of France; but the idea of von Luschan that, wherever it occurs, we should suppose it borrowed from those ancient hunters, will scarcely recommend itself to sober readers.

The ornamentation on the utensils from the Admiralty, Kaan and adjacent islands is judiciously analyzed, and the conventional modifications of the human figure skillfully explained. The wood-carving of New Ireland and the masks worn in the festivals supply other passages with suggestive matter. The work is a valuable contribution to the anthropology of the regions mentioned. D. G. BRINTON.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES—SECTION OF BIOLOGY, MARCH 14, 1898.

MR. BRADNEY B. GRIFFIN reported on the *Nemertina* collected by himself in Puget Sound and Alaska. After briefly reviewing the previous work upon North Pacific *Nemertina*, he urged the priority of Stimpson's generic terms *Emplectonema* and *Diplopleura* in place of *Eunemertes* and *Langia;* he commented upon the occurrence of closely related though distinct species on the west coasts of both Europe and North America. The occurrence of *Cerebratulas marginatus Renier* was recorded. Among the new species described is a new *Carinoma* which occurs abundantly and presents two or three varieties, one of which burrows in the hard clay among Pholads. The remaining new species are distributed as follows: *Carinella* 2, *Amphiporus* 4, *Lineus* 1.

Mr. W. H. Hornaday described the destruction of bird life in the United States, from data which he secured from all parts of the country. Circulars containing the following questions were sent out to trappers, guides, sportsmen and naturalists in all parts of the United States:

(1) Are birds decreasing in your locality? (2) How many birds are there now compared with fifteen years ago? (3) What are the most destructive agents? (4) Are any birds becoming extinct? The answers came from all but four States and Territories and showed surprising agreement. The most destructive agencies are sportsmen, plume-hunters, boys after eggs, pot-hunters, fire, English sparrows, etc.; and through these it has been estimated that there has been a decrease of 46 % during the last fifteen years. It was shown that game and edible birds are becoming scarce, and that song birds are being used for food in their stead; that plume-birds are becoming extinct, and that destructive agencies are increasing. Mr. Hornaday concluded with an appeal for more drastic measures in our game laws and for their careful execution.

Mr. N. R. Harrington reported on a collection made by himself of Crustacea from Puget Sound, worked up by W. T. Calman, University College, Dundee, Scotland. The paper dealt with sixty-three species, three of which were new, and several little known. Perhaps the most interesting part of the work related to a parasite, *Pseudioni giardi* n. sp., of which male, female and larva were all described from a single specimen found on *Eupagurus ochotensis*. A new species of amphipod, *Polycheria osborni*, is interesting, because the only other known representative of this genus is found in the Antarctic region. The collection is divided up as follows: *Macrura*, 15 species, thirteen of these being shrimps; *Brachyura*, 34 species; *Isopoda*, 6 species; *Amphipoda*, 3 species; *Copepoda*, 1 species.

The final paper was given by Mr. H. E. Crampton on his experiments on insect grafting, and upon one case in particular, where the colors of scales of one species were imposed upon the scales of another. GARY N. CALKINS,

Secretary of Section.

NEW BOOKS.

A Text-Book on Roofs and Bridges. Part IV., *Higher Structures.* MANSFIELD MERRIMAN, HENRY S. JACOBY. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. 1898. Pp. ix+276.

Introduction to Electro-Chemical Experiments and Practical Exercises in Electro-Chemistry. FELIX OETTEL; translated by EDGAR F. SMITH. Philadelphia, P. Blakiston, Son & Co. 1897. Pp. vii+143, 75 cents; and pp. vii+92, 75 cents.

Alternate Currents in Practice. Translated from the French of Loppé and Bouquet, by FRANCIS J. MOFFETT. London, Whittaker & Co.; New York, The Macmillan Co. 1898. Pp. 376. $5.

La photographie et l' étude des nuages. JACQUES BOYER. Paris, Mendal. 1898. Pp. 80.

SCIENCE

FRIDAY, APRIL 22, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*A CENTURY OF GEOGRAPHY IN THE UNITED STATES.**

MEN and women occupied with the small and special details of a large and complex work are not well situated for understanding the scope of the large work to which they contribute. The shop girl in Waterbury who spends her days and years in cutting threads on tiny screws may have very limited knowledge and erroneous opinions about the watch industry. The trained arithmetician who spends his months and years in adjusting triangulation or verifying computation does not thereby acquire valuable opinions as to the scope and conduct of a great national survey. In our day many, if not all, branches of human knowledge and activity are widening. As they widen they are specialized. The student of nature, the practitioner of medicine or law, the artisan, each is prone to contract the size of his field of activity and to study more profoundly some small part of the large subject. Even the farms grow smaller and are better cultivated than formerly. Such subdivision of the field of study and activity into special and smaller fields has for a century at least progressed steadily, and the world has gained thereby. Many have become profoundly learned or highly skilled in some small subject. You

* The annual Presidential address before the Philosophical Society of Washington, delivered April 2, 1898.

will recall the story of the German professor who, near the close of a long life devoted to the dative case, regretted that he had chosen so large a field. "I ought," said he, "to have confined myself to the iota subscript." I will not deny—nay, I am persuaded—that the specialization of which I speak is wise, that by it the welfare of the race is promoted. But, while this is so, it should ever be borne in mind that specialized knowledge is not a substitute for general knowledge. It is something called for by the increased and increasing sum of human knowledge; but if by it the number of students of larger and unspecialized fields is greatly reduced harm may, indeed must, result.

My purpose, however, is not to call attention to possible perils from undue specialization, for before this audience that is unnecessary. The subject has been discussed and is well understood.

For many years my work has been along geographic lines, and this has led me to select as the theme for this annual address *the Geography of the United States*—not its mathematical geography, nor its physical geography, nor its political geography, nor its commercial geography, any one of which might be treated with more ease than the general subject. And yet a consideration of the whole field and a picture of the general progress made in the geography of the United States since its creation will, it is hoped, prove profitable—more profitable, indeed, if well done, than a more minute examination of a more limited subject. It is not uncommon when a subject of large scope has been chosen to hear the comment: "He has chosen a large subject," and sometimes we think we see in this an implied opinion that the speaker shows either unwisdom or audacity in such choice. I will not deny that either or both may be true in this case, but will at once invite you to follow me in a most general review of a century's progress in the diffusion of geographic knowledge in and as to the United States.

It is not to the details or agencies by which our knowledge has been acquired that I would draw attention. This has already been done many times. In the stout and repulsive black volumes that for years have, from the government printing office, been poured out over the country without stint or price—in these are set forth with elaborate minuteness the geographic work done by the United States. The particular fields investigated by boundary surveys, by the Coast Survey, by the General Land Office, by the Lake Survey, by the Pacific Railroad Surveys, by the Wilkes Exploring Expedition, by the Rogers Exploring Expedition, by the so-called Hayden, Wheeler and Powell surveys, by the Northern Transcontinental survey, by various State surveys, topographic and geologic, and by the U. S. Geological Survey—all these are duly recorded and published in scores of forbidding black volumes. These volumes record the *increase* in geographic knowledge, but throw little light on its *diffusion*. For *this* we look to the text-books, to public addresses in Congress and out, to newspaper and magazine articles and to public lectures. These reflect the general knowledge of the community as to geography. This phase of the subject shall be our theme.

It is now one hundred and nine years since thirteen sovereign and independent States, loosely bound together in a confederation, agreed to form a 'more perfect union.' By a narrow majority and after protracted debate they accepted the terms of an instrument which bound them in an indissoluble Union. In April, 1789—one hundred and eight years ago—Washington was inaugurated. That we may clearly note our geographic progress since that event let us picture to ourselves in broad

outline the geographic environment of that time.

The total area of the original thirteen States was 830,000 square miles, an area a little larger than Alaska. The population was about 4,000,000, or a little more than that of Greater New York to-day. Of the whole area only about 30 per cent. contained any population, and even within this area the people were gathered for the most part in a narrow fringe along the Atlantic seaboard. The largest city was New York, with a population of 33,000—*i. e.*, it was about as large as the Yonkers or Youngstown of to-day. Waterbury, Connecticut, with a population of 29,000, is a little larger than was Philadelphia in 1790. Boston contained a population of 18,000; Charleston, South Carolina, 16,000; Baltimore, 13,000, and Salem, Massachusetts, 8,000. After these only thirteen others, all still smaller, find a place in the first census.

Maine was a province of Massachusetts, with a northeastern boundary undefined and awaiting an international boundary conference for its determination. Most of its territory then was, as some still is, barely explored. To the north, then as now, was a British province; to the west and south, Spanish possessions. This phrase 'Spanish possessions' must here be taken in a Pickwickian sense, for these regions owned by Spain were still almost exclusively possessed by the aborigines.

Traveling was chiefly done on horseback and by stages. The days of railroads and steamboats were in the future. Even the system of canals and national highways, so much exploited in the early decades of the century, was not yet begun.

Of maps of the region there were several, fairly good for their time. None of them, however, were based on surveys. The maps of Thomas Jefferys, geographer to King George during the Revolutionary period, are as a whole the best, and fairly representative of the geographic knowledge then existing. While these maps of Jefferys, as well as others, recorded the best geographic information then extant, it does not appear that the information they contained was widely diffused. General ignorance as to geography must have been great. Noah Webster, the lexicographer, writing in 1840, says of the teaching in the schools when he was a boy:

"When I was young, or before the Revolution, the books used were chiefly or wholly Dilworth's spelling books, the Psalter, Testament and Bible. No geography was studied before the publication of Dr. Morse's small books on that subject, about the year 1786 or 1787. * * * Except the books above mentioned, no book for reading was used before the publication of the Third Part of my Institutes, in 1785. In some of the early editions of that book I introduced short notices of the geography and history of the United States, and this led to more enlarged descriptions of the country."

Thus we learn that geography teaching began with a few geographic notes inserted in a spelling book published just prior to Washington's inauguration.

Dr. Morse, to whom Webster here refers, was the Rev. Jedediah Morse, minister of the Congregational church in Charlestown, Massachusetts. He published, in 1789, an octavo volume of 534 pages, entitled 'The American Geography.' This book was, four years later, greatly enlarged and published in two volumes with the title 'The American Universal Geography.' A fourth edition, extensively revised, appeared in 1801 or 1802, a fifth in 1805, a sixth in 1812 and a seventh in 1819. The *fifth* edition of 1805, and presumably all later ones, was accompanied by a little quarto atlas containing about sixty maps and entitled 'A New and Elegant General Atlas,' drawn by Arrowsmith and Lewis.

As a special writer on geography Morse

appears to have been the first American in the field. He continued to write for many years, and after his death the son published revised editions of his father's works. As Morse's geographies, or abridgements of them made by himself or others, were extensively used in the schools, we may now learn from them something of the 'state of the art,' as our patent experts and attorneys would say, of geographic teaching in the early years of the century.

It is worth while to note, in passing, the high esteem in which the work of Morse was held. The numerous editions called for and sold at home, and its translation and sale abroad, attest its value. Samuel G. Goodrich, who wrote so much over the name Peter Parley, referring to his boyhood school days, about 1800 to 1810, in Ridgefield, Connecticut, says:

"When I was there two Webster's grammars and one or two Dwight's geographies were in use. The latter was without maps or illustrations, and was in fact little more than an expanded table of contents taken from Morse's Universal Geography—the mammoth monument of American learning and genius of that age and generation."

The third edition of Morse's abridgement was published in 1791. As to maps it contains only crude diagrams of the world, of the continents and of the United States. For the most part, therefore, it is clear that our grandparents got vague and crude ideas of geographic situation, extent and relation, since clear views of these are not gained without maps—sometimes, indeed, not even with them. The points emphasized by Morse are the points which were of commanding interest and importance in his day.

Fertile soil, healthy climate, but especially transportation routes, are described in general and in particular and are dwelt upon. The facilities which the rivers and lakes afford for commerce impressed our forefathers much more forcibly than even to-day the water routes to the Klondike impress the imagination of the gold-hunter.

You will recall that on the old maps the Ohio river appears as *La Belle Riviere*—the beautiful river. To the French voyageurs *La Belle Riviere* was more than a mere name. Its deep and placid waters, affording an easy and delightful natural highway for a journey almost a thousand miles long, unbroken by falls or rapids, were to them indeed beautiful. Of it Morse says:

"The Ohio is the most beautiful river on earth. Its gentle current is unbroken by rocks or rapids except in one place. It is a mile wide at its entrance into the Mississippi and a quarter of a mile wide at Fort Pitt, which is 1,188 miles from its mouth."

This distance, 1,188 miles, has now shrunk to 965 miles.

As to the Mississippi he says:

"The principal river in the United States is the Mississippi, which forms the western boundary of the United States. It is supposed to be 3,000 miles long and is navigable to the falls of St. Anthony."

In the numerous lakes and rivers scattered over the land Morse saw a bond of union between the future settlers. He points out the ease with which a complete network of waterways might be constructed and its effect. He says:

"By means of these various streams and collections of water the whole country is checkered into islands and peninsulas. The United States, and indeed all parts of North America, seem to have been formed by Nature for the most intimate union. For two hundred thousand guineas North America might be converted into a cluster of large and fertile islands, communicating with each other with ease and little expense and in many instances without the uncertainty or danger of the sea."

The *Western Territory* at this time (1790)

comprised what is now Ohio, Indiana, Illinois, Michigan, Wisconsin and Minnesota. It was practically without settlers. Morse guesses that it contained 6,000 French and English immigrants and negroes. As to this region, but more particularly Ohio, Indiana and Illinois, says Morse:

"It may be affirmed to be the most healthy, the most pleasant, the most commodious and most fertile spot of earth known to the Anglo-Americans. The design of Congress and the settlers is that the settlements shall proceed regularly down the Ohio and northward to Lake Erie."

It will be remembered that at this early date Congress met in Philadelphia. The longitudes given by Morse are reckoned from Philadelphia. Where the future capital of the United States was to be, no one then knew. The selection of the present site was actually made by Congress in 1790. Before Morse had knowledge of such selection he indulged in this bit of speculation as to the future capital. Speaking of the future State of Ohio, then nameless, he says:

"The center of this State will fall between the Scioto and the Hokhoking. At the mouth of these rivers will probably be the seat of government for this State; and, if we may indulge the sublime contemplation of beholding the whole territory of the United States settled by an enlightened people, and continued under one extended government, on the river Ohio and not far from this spot will be the seat of empire for the whole dominion."

As to the region west of the Mississippi, it was then Spanish. Originally French by discovery and occupation, it had passed from France to Spain by cession in 1763. In the light of what it now is, a few words from Morse's speculations in 1791 as to its future throw light on the geography of his time. He says:

"A settlement is commencing, with advantageous prospects, on the western side of the Mississippi, opposite the mouth of the Ohio. The spot on which the city is to be built is called New Madrid, after the capital of Spain. The settlement, which is without the limits of the United States, in the Spanish dominions, is conducted by Colonel Morgan under the patronage of the Spanish King."

New Madrid, Morse thought, was to become a great emporium of trade unless the free navigation of the Mississippi should be opened to the United States, and this, he thought, would not occur without a rupture with Spain.

Some had thought that all settlers beyond the Mississippi would be lost to the United States. Morse discusses this at some length, and concludes with a paragraph which we quote entire:

"We cannot but anticipate the period as not far distant when the American Empire will comprehend millions of souls west of the Mississippi. Judging upon probable grounds, the Mississippi was never designed as the western boundary of the American Empire. The God of Nature never intended that some of the best parts of his earth should be inhabited by the subjects of a monarch 4,000 miles from them. And may we not venture to predict that, when the rights of mankind shall be more fully known—and the knowledge of them is fast increasing both in Europe and America—the power of European potentates will be confined to Europe, and their present American dominions become, like the United States, free, sovereign and independent empires."

These sentiments have ever taken deep root in the United States. When President Monroe, more than a quarter of a century later, wrote the State paper that has forever linked his name with the sentiment: 'America for the Americans,' he did not create or express new or strange doc-

trines, but simply gave expression to an abiding conviction of the American people.

Such in brief is a word picture of the geography of the United States at the beginning. Let us now go forward a generation, to about 1820, and note the changes. Our second and, let it be hoped, last war with Great Britain is over. By the first war political independence was won, by the second commercial freedom. Our ships might now go where and when they would, freed from hateful and hated search by any foreign power. Freedom from dependence on foreign manufactures had taken root and was making vigorous growth. It is difficult to fully realize the burning zeal with which every one was imbued to make the United States dependent upon nothing but itself. It was not enough to be politically free. Freedom was not fully won so long as we were compelled to depend upon foreign powers for anything whatsoever. In the introduction to his little geography of 1791, Morse voices these sentiments. He says:

"It is to be lamented that this part of education (geography) has hitherto been so much neglected in America. Our young men, universally, have been much better acquainted with the geography of Europe and Asia than with that of their own State and country. The want of suitable books on this subject has been the cause, we hope the sole cause, of this shameful defect in our education. Till within a few years we have seldom pretended to write, and hardly to think for ourselves. We have humbly received from Great Britain our laws, our manners, our books and our mode of thinking; and our youth have been educated rather as the subjects of the British King than as citizens of a free republic. But the scene is now changing. The Revolution has been favorable to science, particularly to that of the geography of our own country."

The great lexicographer, Noah Webster, was inspired by the same views when preparing his dictionary; and especially did that great democrat, Jefferson, strive unceasingly to complete the independence of which the political part was definitely secured by the peace of 1783.

He would not have us reckon our longitude from a foreign meridian, or depend upon a foreign country for an ephemeris or for coast charts. Accordingly, in 1804, a meridian through the Executive Mansion was surveyed and marked on the ground as the first meridian of the United States. The name Meridian Hill survives in testimony of this. In 1807 the Coast Survey was created to accurately chart our coasts for purposes of commerce and defense, and in 1804 the famous expedition of Lewis and Clarke to the Pacific ocean expanded our political and mental horizon in matters geographic. A great system of national highways, both roads and canals, was projected and pushed forward. The practical introduction of steamboats stimulated progress. Lake Champlain was connected with the Hudson by a canal, while work upon 'Clinton's ditch,' or the Great Western Canal, as the Erie Canal was then called, was being pushed forward with great energy. The object of this canal, as Morse tells us, was 'to turn the trade of the western country from Montreal to New York.'

In 1791 there were only 89 post-offices in the United States. Twenty-five years later, in 1817, there were 39 times as many, 3,459. Each day in the year (1791) the mails were carried 10,000 miles by stages and 11,000 on horseback and in sulkies. Mail was carried along one continuous route from Anson, in the district of Maine, via Washington, D. C., to Nashville, Tennessee, 1,448 miles; another mail route was from St. Marys, Georgia, via Washington, D. C., to Highgate, in Vermont, 1,369 miles. These were the longest mail routes in the United States. Postage stamps were

not yet invented, and the postage on each letter, which was limited to a single sheet of paper, was 25 cents.

The beginning of the third decade, or about 1830, may be regarded as marking the decadence of that grand scheme of internal communication by canals and national highways which had hitherto filled the imaginations of statesmen and publicists. The railroad had been born and a revolution had begun, the end of which not the wisest could or can foresee. To this railroad system were we indebted, and we are still indebted, for a stimulus to geographic research which has continued undiminished to our own day.

The twelfth edition of a school book on geography by Daniel Adams appeared at Boston in 1830. This book appears to have been revised and brought down to 1827. A few extracts from it will give a picture of the geographic knowledge then existing. He says:

"Vessels are from 5 to 30 days on their passage up to *New Orleans*, 87 miles, although with a favorable wind they will sometimes descend in 12 hours. From New Orleans to Natchez, 310 miles, the voyage requires from 60 to 80 days. Ships rarely ascend above that place. It is navigable for boats carrying about 40 tons and rowed by 18 or 20 men to the falls of *St. Anthony*. From New Orleans to the Illinois the voyage is performed in about 8 or 10 weeks. Many of these difficulties, however, now are overcome and much is gained by the successful introduction of steam navigation."

The children in our schools to-day are asked, among other things, to set forth the advantages for commerce possessed by the Western States. This is the answer to that question which Mr. Adams furnished to their grandparents. As to these Western States, which comprise all west of the Alleghany mountains, he says:

"The remote situation of this country from the seaboard renders it unfavorable to commerce. This inconvenience, however, is in some degree remedied by its numerous large and navigable rivers, the principal of which is the Mississippi, the great outlet of the exports of these States; but such is the difficulty of ascending this river that most of the foreign goods imported into this country have been brought from Philadelphia and Baltimore in wagons over the mountains, until the invention of steamboats, by which the country now begins to be supplied with foreign goods from New Orleans."

The following passage, also from Adams, throws strong light on the knowledge current in 1827 as to the great prairies of the West:

"Pilkava prarie or plain is a high, level ground in this State (he is speaking of Indiana), seven miles long and three broad, of a rich soil, on which there was never a tree since the memory of man. Two hundred acres of wheat were seen growing here at one time a few years since yielding fifty bushels on an acre."

Missouri Territory at this time, so wrote Adams:

"Extends from the Mississippi on the east to the Pacific ocean on the west, and from the British possessions on the north to the Spanish possessions on the south."

In all this great region the only features mentioned by Adams are the Mississippi, Missouri and Columbia rivers, the Rocky mountains and Astoria. St. Louis, with a population of 4.600, was the center of the fur trade. Similarly Detroit, in Michigan Territory, with a population of 1,400, was a fur-trading station, while western Georgia was still in possession of the Indians called Creeks, 'the most warlike tribe this side the Mississippi.'

"The White mountains," he tells us, "are the highest not only in New Hamp-

shire, but in the United States. Mt. Washington, the most elevated summit, has been estimated at about 7,000 feet above the level of the sea."

Finally, as to Alaska the golden, from which so much of wealth and of disappointment is to come, our author couples it with Greenland and dispatches it in this one sentence:

"There are also Greenland, on the northeast (of North America), belonging to Denmark, and the Russian settlements on the northwest, both of small extent and little consequence."

These citations serve to indicate the horizon of geographic knowledge 70 years ago, a horizon which was steadily widening. Stories of wondrously fertile lands west of the Alleghenies found their way to the rocky and sterile farms of the East, and a steady stream of migration to better lands, where the struggle for existence should be less severe, poured over the Alleghenies and onward toward the sunset. In the vanguard was the government surveyor measuring out the land and subdividing it for farms. Working hurriedly in a wilderness, among native tribes not always friendly, his surveys were not, perforce, accurate, nor indeed was it important they should be. They yielded a basis for titles to homesteads and for clear and easily understood descriptions. The results of these subdivisional surveys constitute substantially the only bases for the maps for much the greater part of all of our 'Great West' to this day.

Already before 1840 the question of supremacy of canal or railroad had been settled. In Peter Parley's geography of 1840 a tabular exhibit of railroads and of canals in the United States shows that there were then 46 canals, with a total mileage of about 4,800 miles, and 88 railroads, with a total mileage of nearly 7,700 miles. Progress in railroad-building demanded surveys and maps. Accordingly these were made; knowledge of geography was increased, and increased at a rapid pace. Whenever a little known region is found to possess wealth or the means of its rapid acquirement, knowledge of the geography of that region increases extraordinarily fast. Witness the increase and diffusion of knowledge as to Alaska in the past twelve months. The peaceful expanding of our horizon of geographic knowledge continued steadily and uniformly. But crises in human affairs sometimes hasten progress; wars, rumors of wars even, sometimes make possible the seemingly impossible.

The northern boundary of the United States, from Maine to the crest of the Rocky mountains in Montana, as we now see it on the maps, was definitely settled in 1842. For more than half a century prior to that date this frontier had been in dispute between Great Britain and the United States. Repeated attempts to settle it had met with repeated failure. Boundary disputes, as we know, are ever long-lived and bitter. In April of the year 1842 Lord Ashburton arrived in Washington with full power to negotiate a treaty for settling this old and irritating controversy. Webster was then Secretary of State in the Cabinet of President Harrison. Before the year had ended, a treaty, now known as the Webster-Ashburton treaty, had been drafted, agreed to, signed, ratified and proclaimed as the law of the land. Webster regarded this settlement as 'the greatest and most important act of his eventful life.' That the settlement was just may be inferred from the fact that it displeased both parties and both Webster and Ashburton were criticised at home for sacrificing the interests of their respective countries.

But this treaty line stopped at the crest of the Rocky mountains and immediately there arose the Oregon question. That

question was whether Great Britain or the United States owned the territory which now comprises western Montana, Idaho, Oregon, Washington and British Columbia. Much bitterness and angry contention followed before the 49th parallel was, in 1846, finally agreed upon as the boundary. The debates in Congress and in Parliament during the years 1842–1846, and articles in leading journals and reviews, after generously discounting their partisan overstatement, clearly portray the then prevailing knowledge, or rather, should I not say, the prevailing ignorance, as to the whole region west of the Mississippi.

Mr. Winthrop, of Massachusetts, in 1844, in the House of Representatives, cited with approval these words spoken by Benton, in the Senate, in 1825:

"The ridge of the Rocky Mountains may be named without offence as presenting a convenient natural and everlasting boundary. Along the back of this ridge the western limits of the Republic should be drawn, and the statue of the fabled god Terminus should be raised upon its highest peak, never to be thrown down."

On January 25, 1843, Senator McDuffie, of South Carolina, speaking of the country now embraced in the two Dakotas, Nebraska, Kansas, and thence northwestward to Oregon and Washington, said:

"What is the character of this country? Why, as I understand, that seven hundred miles this side of the Rocky Mountains is uninhabitable, where rain scarcely ever falls—a barren and sandy soil—mountains totally impassable, except in certain parts. Well, now, what are we going to do in such a case as that? How are you going to apply steam? Have you made anything like an estimate of the cost of a railroad running from here to the mouth of the Columbia? Why, the wealth of the Indies would be insufficient! You would have to tunnel through mountains five or six hundred miles in extent. Of what use will this be for agricultural purposes? I would not, for that purpose, give a pinch of snuff for the whole territory. I wish it was an impassable barrier to secure us against the intrusions of others. If there was an embankment of even five feet to be removed, I would not consent to expend $5 to remove that embankment to enable our population to go there. I thank God for his mercy in placing the Rocky Mountains there."

A writer in the *Westminster Review*, in 1846, thus describes the great plains of Nebraska, Kansas and Oklahoma:

"From the valley of the Mississippi to the Rocky Mountains the United States territory consists of an arid tract extending south nearly to Texas, which has been called the Great American Desert. The caravan of emigrants who undertake the passage take provisions for six months, and many of them die of starvation on the way."

Indeed, the question much debated at the time was: Is Oregon worth saving? Both Winthrop and Webster were of opinion that the government would be endangered by a further enlargement of territory. Mr. Berrien declared that the region under discussion was a barren and savage one, as yet unoccupied, except for hunting, fishing, and trading with the natives, while Mr. Archer said the part near the coast alone contained land fit for agricultural purposes, and there were no harbors which were or could be rendered tolerable. And yet, out of all this hot debate and war talk, there emerged in 1846 peace, Oregon and the forty-ninth parallel. And out of all the ominous mutterings in 1898, and the fever heat that is now at the danger line, there will emerge—I am not a prophet, but let us hope, there will emerge—white-winged peace, honorable to Spain and to us, justice for all, and freedom for Cuba.

Three years later came the discovery of gold in California. Then California, as now

Klondike, set the imaginations of men on fire. Long caravans of ox teams in endless succession wended their slow way across the plains, the mountains and the deserts to the sunset land of gold. Government surveys for a railroad promptly followed, and crude and imperfect knowledge as to the region rapidly gave place to better, though still defective, knowledge of the *Great West.*

Then came war and the need of war maps. All available agencies for their production for the use of army and navy were drawn upon, and the need of topographic maps for military purposes, hitherto clear to the few, was now made clear to the many.

In the years immediately following the Civil War several events occurred which gave a fresh impetus to geography. The completion of a railroad across the continent had a profound significance and importance. It was a bond of iron which, shortening the time and distance between East and West, bound them closer in ties of affection and interest. The Western pioneer of '49 and '50 could revisit his old home and friends in the East, and opportunity was afforded to many in the East to get some personal knowledge of the boundless West.

In 1867 Alaska was purchased. The discussions in Congress and out preceding and following that purchase were spread abroad and taught Alaskan geography to the masses; and yet there was little to teach, for but little was known. The government, the great agency of geographic research in this country, at once began to explore its new purchase, to survey and to map it. This work has, with varying vicissitudes, continued to this very year, when the work of exploration and survey is, under the stimulus of gold discoveries, being conducted on a scale never hitherto attempted there. It was in that same year, 1867, that Major J. W. Powell made his adventurous voyage down the Colorado river and brought the world its first clear knowledge of the *Grand Cañon*, greatest of all Nature's wonders in our land. It was shortly after this that from the Hayden Survey came tidings of that region of wonders—the Yellowstone Park.

In the thirteen years immediately following the Civil War three national surveys were engaged in the West in gathering information as to the character and extent of the natural resources of the Western Territories—Territories, for the most part, then containing few inhabitants but Indians. The rise of these surveys was rapid, the results secured interesting and valuable, and their rivalry and clashing inevitable. Many thousands of square miles of territory were roughly mapped out, and many books and reports, both popular and scientific, were produced.

In 1878 a reorganization was proposed and the National Academy of Sciences asked to submit a plan. This it did, and submitted it to Congress. The outcome was the present United States Geological Survey, created in March, 1879. It replaced the prior organizations, familiarly known as the Hayden, Powell and Wheeler Surveys.

The work laid out for the newly-created Geological Survey was geological, and its field the *national domain.* What is the *national domain?* Is it restricted to the Territories and places actually occupied by the United States, or does it embrace every spot where the Stars and Stripes may float? Congress, after a long debate, answered this question and authorized surveys to be made in every part of our whole Union. Again, geological investigations can not be satisfactorily made, nor geological results satisfactorily exhibited, without maps, topographic maps—*i. e.*, maps which show the shapes and forms as well as positions on the

surface. Such maps did not exist. A fragment here and there, to be sure, existed —a fringe of sea and lake coast; but these constituted only a bare beginning. Accordingly, in 1882 authority was given and the beginning of the mighty task of making a topographic map of the United States was begun. That work has for sixteen years progressed without interruption, and to-day we have contour topographic maps covering more than 600,000 square miles. In almost every State and Territory in the Union work has been done, while Massachusetts, Connecticut, Rhode Island, New Jersey and the District of Columbia are completely mapped.

That the prosecution of this work and the distribution of the maps has profoundly influenced interest in and knowledge of geography in the United States goes without saying. These maps are in the hands of engineers, of projectors of improvements, of teachers, of text-book makers, and of geographic students everywhere. The standards of school geographies have risen, methods of geographic teaching have been changed, and a better understanding of the relations of environment produced.

And thus the first century of progress in geography ends with a rate of progress, both in research and teaching, never surpassed. That which has been already accomplished is great; yet it is but a small part of that which remains to be done.

MARCUS BAKER.

U. S. GEOLOGICAL SURVEY.

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*ON THE INHERITANCE OF THE CEPHALIC INDEX.**

(1) THE cephalic index, when used to test any theory of heredity, possesses many merits, and at the same time one or two defects. In the first place it is supposed to be a marked racial character, and, therefore, might be considered to be strongly inherited. In the next place it remains sensibly constant after two years of age; thus the strength of inheritance can be ascertained by measurements on young children, whose parents are more frequently alive than if we have to wait for measurement till the offspring are of adult age. Further, although the cephalic index requires a more trained hand to measure it than some other measurements on the living subject, the trained observer will always deduce sensibly the same results;* on the other hand, stature measurements vary sensibly with the hour of the day and with the observer. The need of a moderately trained observer is the chief defect of cephalic index measurements; it hinders the rapid collection of numerous family measurements; the difficulty, further, of satisfactorily measuring the female head without some derangement of the toilet is a further hindrance.† The merits of the cephalic index, however, as a test of heredity far surpass its demerits. A well-organized measurement of the cephalic index in pairs of relatives would probably give the best results available for the laws of inheritance. The cephalic index measured on the living head is, of course, not so satisfactory as that measured on the skull, but the latter may be considered, even with the aid of Röntgen rays, as at present quite out of the question. The following paper has been worked out, not on very good material or on material collected with the present end in view, but on the only material that seemed at present available. It suffices

* 'Mathematical Contributions to the Theory of Evolution.' By Miss Cicely D. Fawcett, B.Sc., and Professor Karl Pearson, M.A., F.R.S., University College, London. Read before the Royal Society, February 17, 1898.

* This has been tested by frequent measurements of the same heads.

† The recent establishment of an anthropometric laboratory at Newnham College will, it may be hoped, remove the difficulty about head measurements on female students felt by the Cambridge Anthropmetric Committee.

to justify the view that the inheritance of the cephalic index offers a most satisfactory method of testing the laws of heredity.

(2) Owing to the kindness of Mr. Francis Galton, the Department of Applied Mathematics in University College, London, was placed in communication with Dr. Franz Boas, of the American Museum of Natural History, who is well known for his elaborate system of measurements on North American Indians. With extreme kindness, Dr. Boas* at once forwarded to England upwards of 1,000 sheets of measurements on comparable Indian tribes. These tribes, however, contain extremely mixed blood. In the fewest cases were pure Indian ancestors noted; one of the grandparents at least exhibited, as a rule, European blood —English, Dutch, French, Irish, etc. Dr. Boas himself writes:

"I could not give you any series that was sufficiently extensive and embraced pure Indians only, because among these tribes the determination of relationships offers peculiar difficulties. I am afraid that your results may also bring out the looseness of family relations. I should not be surprised if the relation between father and child were much lower than that between mother and child, because often another person is actually the father of the child."

Dr. Boas's last surmise is amply verified; it will be found from the table below that the coefficient of heredity between father and son is abnormally small, while that between father and daughter is actually less than the probable error of this series of measurements! If we put upon one side any purely hypothetical supposition that illegitimate births are more likely to be female than male there would seem reason to suppose some native custom by which it is held less discreditable to pass off a daughter than a son upon the titular husband. It may be asked whether, if the racial mixture is so great and the paternity so obscure, it was worth while to undertake the lengthy arithmetic* required to determine the heredity correlations. The answer is threefold: (*a*) if Galton's law of ancestral heredity be correct, inheritance is not a racial character, but a general law of living forms, and racial mixtures will not influence the result; (*b*) the results show that obscure paternity does not prevent good values being found for other relationships; in fact, the fulfilment of Dr. Boas's surmise is in itself not without value, as showing how well our algebraic theory fits itself to the facts; it might almost be said to provide a scientific measure of the conjugal fidelity of a race; (*c*) it is always worth while to undertake an investigation on the best material available, even if it be poor material for this purpose, for it emphasizes the need of new and more elaborate observations.

(3) It will be seen from the table that it has only been possible to determine the coefficient of heredity for small series, varying from 80 to 143 pairs of the seven relationships, four corresponding to the first degree of direct kinship and three to the first degree of collateral kinship. The probable errors are, as might be expected from such small series, large. Putting aside the paternal relationship, we are justified in drawing certain general conclusions, which may be thus summed up:

(*a*) The coefficients of heredity, as dedetermined from the cephalic index, differ in all cases from those determined for stature by less than their probable error and, therefore, by less than the probable error of their difference. The stature coefficients were obtained for the English

* It is difficult to sufficiently emphasize the disinterested service to science of men who do not 'monopolize' their anthropometric measurements.

* We have to thank Mr. Leslie Bramley Moore for much aid in extracting the head measurements from the slips and calculating cephalic indices.

middle classes.* We thus conclude that these results confirm Galton's law in so far as they tend to show that the strength of *inheritance is not a character of race or organ.* They do not, however, exceed the limits of errors of observation. In the case of mothers and sons the divergence is very slightly above the probable error; the observed and theoretical values are identical in the case of mothers and daughters; they are less than the probable error for brothers and brothers and only slightly larger than it for brothers and sisters; for sisters and sisters the divergence is about one and a-half times the probable error. The mean weighted values of the coefficients for direct and collateral kinship are 0.3366 and 0.4004, the former differing by less than half its probable error from the theoretical value 0.3000, and the latter sensibly identical with its theoretical value, 0.4000.

INHERITANCE OF CEPHALIC INDEX—TABLE OF VALUES.

Relation.	No.	Mean.	S. D.†	Coefficient of correlation.		
				Cephalic Index.	Stature.	Theory.
Fathers.	131	80.55±0.18	3.064±0.128	[0.2245±0.0560]	0.3959 ±0.0259	0.3000
Sons	131	81.53±0.20	3.432±0.143			
Fathers.	108	80.41±0.22	3.428±0.158	[0.0490±0.0647]	0.3603 ±0.0276	0.3000
Daughters	108	81.90±0.26	3.976±0.182			
Mothers	104	80.80±0.20	3.020±0.141	0.3696±0.0571	0.3018 ±0.0279	0.3000
Sons	104	81.55±0.23	3.524±0.165			
Mothers	82	80.88±0.28	3.843±0.202	0.3000±0.0603	0.2841 ±0.0292	0.3000
Daughters	82	81.53±0.31	4.143±0.218			
Brothers	139	80.57±0.19	3.652±0.136	0.3787±0.0490	0.3913 ±0.0232	0.4000
Brothers	139	81.42±0.21	3.765±0.152			
Brothers	143	81.58±0.20	3.490±0.139	0.3400±0.0499	0.3754 ±0.0170	0.4000
Sisters	143	81.38±0.20	3.588±0.143			
Sisters	80	82.10±0.27	3.636±0.194	0.4889±0.0574	0.4436 ±0.0222	0.4000
Sisters	80	81.84±0.16	4.069±0.217			

Cephalic index is clearly not more strongly inherited than stature. Its variability is also very much that of stature. It is accordingly difficult to see why it should be considered as peculiarly a racial character.

(*b*) The divergencies between the observed values for the coefficients of inheritance for the cephalic index and the theoretical values obtained on the basis of Galton's law of ancestral heredity are greater than the divergencies between the former and the coefficients for stature.‡

We conclude, therefore, that Galton's law of ancestral heredity gives values for the inheritance within the limits of the probable errors of observation. But,

(*c*) As in the case of stature there is, on

* *Phil. Trans.*, Vol. 187, A, pp. 270–281.

† S. D. = standard-deviation or 'error of mean square.'

‡ It is to be noted that, putting paternity aside, the order of relative magnitude of the coefficients of heredity is precisely the same for both cephalic index and stature.

the whole, a tendency of the coefficients for cephalic index to be somewhat greater than their values as given by Galton's law. It is, therefore, reasonable to suppose that the heredity constant γ (introduced in a paper 'On the Law of Ancestral Heredity') is not, as Mr. Galton takes it, unity, but has some slightly less value.

Other conclusions which may be drawn from the above table are:

(*d*) Among Indians of mixed blood the women are more brachycephalic and more variable than the men. This is in accordance with the general conclusion reached in a paper on 'Variation in Man and Woman,'* namely:

"The lower races give us results in sensible accordance with those we have drawn from the data for ancient civilizations, namely, the women are on the whole more brachycephalic and slightly more variable than the men."

(*e*) The younger generation is more brachycephalic and more variable than its parentage.

The whole of this difference can hardly be due to any change of shape of the skull with old age, for the majority of parents had in this case not passed the prime of life. It may be due to (i) a correlation between dolichocephaly and fertility or between dolichocephaly and philogamy, or (ii) more probably to the action of natural selection (results obtained, but not yet published, by the present writers show a correlation between physique and cephalic index), or (iii) to a greater or less admixture of white blood in the younger generation.

(*f*) Parents of sons are significantly less variable than parents of daughters. This is in accordance with the result previously obtained that mediocre fathers are likely to have sons, † but disagrees with the result for stature—based on a far smaller probability—that mediocre mothers are likely to have daughters.

The conclusions of this paper, while appearing to the writers of interest, are to be taken, in the first place, as *suggestions* for much larger series of measurements and for new lines of investigation.

* Pearson, 'The Chances of Death,' Vol. 1, p. 370.

† '*Phil. Trans.*,' Vol. 187, A, p. 274.

A COMPLETE SKELETON OF TELEOCERAS THE TRUE RHINOCEROS FROM THE UPPER MIOCENE OF KANSAS.

TOGETHER with the very full series of Upper Miocene skulls in the American Museum a complete skeleton of a rhinoceros representing an aged female of very large size, has recently been mounted. We used from materials belonging to several individuals secured by our excavations in Phillips Co., Kansas, under the direction of Dr. Wortman in the months of September, October and November, 1894.

The writer's attention was first drawn to the largely disregarded sexual and age characters of fossil Ungulates in studying the group of Titanotheres; the extinct rhinoceroses conform to the laws which were observed in that group, and which are familiar enough among living types, namely: males, of larger size with more robust and rugose skulls; horns, if present, more prominent; canines largely developed; incisors and anterior premolars disappearing in adults. By the comparison of the 16 skulls and 13 jaws, representing both sexes and all stages of growth, we are enabled for the first time to define positively the animal long known as *Aphelops fossiger*, to distinguish it both from *Rhinoceros* and *Aceratherium*, and to point out its important sexual and individual variations.

We owe to Hatcher the valuable demonstration that *Aphelops fossiger* bore a terminal horn upon the nasals, although he assigned this character to a type which he supposed represented a new species, namely,

Teleoceras major. Hatcher's type of *T. major* proves to be a middle-aged male of *A. fossiger*, and his distinction of *Teleoceras* as a genus supersedes *Aphelops* Cope, because Cope originally applied the term *Aphelops* to *A. megalodus*, defining it as an Acerathere with only three premolar teeth in the lower jaw. This is true of the type species (*A. megalodus*), but this species should, so far as we know at present, be referred to the genus *Aceratherium*, in which the lower premolars vary from four to three in number according to age and individual variation, as in the living rhinoceros.

Our abundant material proves not only that *Teleoceras* is a rhinoceros with a median horn on the tips of the nasals, but that it is fully distinguished from the genus *Rhinoceros* as follows :

	Horns.	Lower Premolars.	Digits.
Genus *Rhinoceros*	Upon anterior portions of nasals	4 in young, 3 in aged individuals	3-3
Genus *Teleoceras*	Upon tips of nasals	3 in young, 2 in aged individuals	3-3

The reduction of the lower grinders to 5 in *T. fossiger* (as compared with 6 in *Rhinoceros*) is a very important and distinctive character, as it absolutely excludes *Teleoceras fossiger* from the ancestry of any of the modern rhinoceroses, and shows it to have represented a distinct side phylum.

EXCAVATION OF THE SKELETON.

The Phillips County Quarry, near Long Island, Kansas, was discovered in 1883 by Mr. Charles Sternberg, who collected for the University of Kansas and for the Harvard University Museum. From the latter collection Scott and Osborn procured materials for the restoration which they published in 1890. Subsequent collections were made by Sternberg and Hatcher for the United States Geological Survey, between 1884 and 1886. Later Professor Cragin collected here, and in 1891 Mr. E. P. West, of the University of Kansas, aided by Mr. T. R. Overton, began the extensive collections which led to the preparation of the skeleton for the University under the direction of Professor Williston. This skeleton, as mounted in the Kansas Museum and described by Williston, gives a much more accurate idea of this animal than the previous restoration by Scott and Osborn, in which the chest is represented as far too shallow.

Its principal dimensions are as follows: Length, not including tail, 9 ft.; height, 4 ft.; greatest girth, 9 ft. 4 in.

The measurements of the American Museum skeleton as mounted are: Length, 10 ft. 2 in. to bend of tail; height at withers, 4 ft. 1 in.; greatest girth, 9 ft. 2 in.

From the above accounts, and especially from our own observations, it is seen that this quarry represents the deposit of some stream or small river along which the rhinoceroses herded in great numbers. In this typical bone-bed are mingled individuals of both sexes and of all sizes, and the proximity of one specimen to another is not a certain guide. There are certain spots, however, where considerable portions of individual skeletons have drifted together. We associate the skull and pelvis in our mounted specimen, for they are of similar age and were found within about six feet of each other, the skull being that of a fully adult female, and the pelvis indicating a corresponding age, because the ilia are united above the sacrum; with the pelvis, moreover, was found a part of the jaw belonging to the skull; also with this pelvis belong a femur, tibia and fibula, astragalus, calcaneum and cuboid of one side, several metacarpals and metatarsals and two cervical vertebræ. The selection of the other limb and foot-bones was made from these as a guide.

Similarly about 300 feet distant were found the principal ribs which have been selected for this mount, characterized by the very rugose appearance and oblique lines for the insertion of the abdominal muscles (*sacro-lumbalis, longissimus dorsi*). Near these ribs were large jaw and limb-

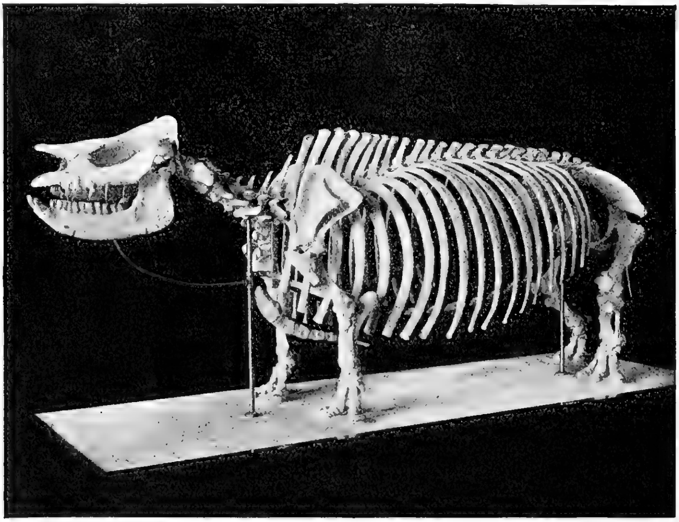

FIG. 1.—Mounted Skeleton of *Teleoceras fossiger*, one-twentieth natural size.

bones corresponding in size with those placed in the mounted skeleton. Apart from these probable associations, the main principle of selection adopted throughout has been that of the age and size standard, after a careful comparison of all the elements. In each region the largest and oldest bones were chosen. Upon this principle the ribs are shown to be of very great length; the chest girth exceeds that indicated in the Scott-Osborn restoration and equals that in the mount in the Kansas Museum, which has heretofore appeared extreme. In additional support of this correlation of material belonging to different individuals, this bone-bed gives evidence of the existence of only one species of rhinoceros, namely, *T. fossiger*. All the differences observed are due to growth, individual and sexual variations, as set forth below.

COMPARATIVE MEASUREMENTS.

	Teleoceras fossiger.		*Rhinoceros indicus.*	
	Feet.	Meters.	Feet.	Meters.
Total length to bend of tail	10. 2	3.10	10.8	3.05
Height, skull	4. 1	1.23		
" withers...........	3.11½	1.21	5.6½	1.69
Breadth, across pelvis......	2.10	0.87	2.8	0.82
" " ribs	2.11	0.89		
Fore limb, total flexed (ball of hum. vert. to ground..	2. 4½	0.7	3.5	1.04
Hind limb, total flexed (ball of femur vert. to ground.	2. 7½	0.80	3.8½	1.13

From the above measurements it appears that from head to tail *T. fossiger* is only six inches shorter than *R. unicornis*, while the back is eighteen inches (.580 mm.) nearer

the ground. This remarkable lowering of the trunk is chiefly caused by the great reduction of the fore arm, fore leg and metapodials. The humerus and femur are respectively only 90 and 110 mm. shorter than in *R. unicornis*, while the radius and tibia (typically shorter elements) are respectively 140 and 130 mm. shorter, and the metacarpals and metatarsals are respectively 90 and 950 mm. shorter. This limb reduction is very striking. At the same time the abdominal girth exceeds that of *R. unicornis*, justifying Cope's conclusion that this animal had rather the proportions of the hippopotamus than of the rhinoceros. It will be recalled that *R. unicornis* has a lower abdominal line than *R. sondaicus* or *R. sumatrensis*, or than either of the African rhinoceroses. *T. fossiger*, therefore, had a totally different external appearance from any existing form.

It may be briefly characterized as a brachycephalic, extremely short-limbed rhinoceros, partly aquatic in its habits, with a very large brain and no diploë of the skull. It parallels the African rhinoceroses *R. simus* and *R. bicornis*, in the form of the humerus, femur and atlas, and in the terminal position of the nasal horn. The occiput, however, is widely different from that of the African rhinoceroses, as well as of *R. sumatrensis*, resembling rather that of *R. unicornis*, although less pitched forward. The limbs are much shorter than in any living type, and, as pointed out by Pavlow, at once recall those of *R. brachypus* and *R. aurelianensis*. A further comparison of *T. fossiger* strengthens the resemblance to the latter form. The proportions of the skull, limbs and metapodials are very similar. In both the cnemial crest of the tibia is double; the secondary folds of the superior molars are similar, as well as the general form of the skull.*

HENRY F. OSBORN.

A NATURAL BRIDGE IN UTAH.

THE remarkable natural bridge illustrated in this article has, so far as I know, never been called attention to before, and is, therefore, entitled to rank as a new discovery among the curiosities of nature. It is an object rivaling the celebrated natura bridge of Virginia in magnitude and even exceeding that classic in interest when one considers its probable origin.

FIG. 1.

The view was taken in southeastern Utah not far from Moab, on the Grand River, in the midst of the great arid region lying west of the Rocky Mountains and some fifty miles from any railway. It was not my good fortune to be able to visit the lo-

* Bulletin American Museum of Natural History, March 18, 1898.

cality myself, but the prints were obtained by me from the original photographer in Moab, when on a somewhat hurried return from a mine examination in the Blue Mountains to the south. The dimensions of the bridge, as estimated by the photographer, are about 500 feet in span and about 150 feet in height. A comparison of the bridge with figures shown in the original photograph in the right-hand corner and with the tree growth near by indicates that these dimensions are quite possible.

The bridge is, in all probability, a monstrous product of wind erosion. The rock appears to be one of the friable Mesozoic sandstones which are widely exposed in this region. Other examples of wind action, such as is illustrated in figure 2, were seen

FIG. 2.

by me while travelling through the country, so located that no other cause could be assigned. Strong and prolonged winds are frequent here, as any one who has sojourned in that country can testify to his misery. The sands carried by these winds are whirled about in the depressions of the rocks, and excavate wind pot-holes in the friable sandstones with great rapidity. A wall or slab of such rock is by degrees entirely penetrated, giving rise to the so-called window rocks which are frequently seen in isolated buttes high above the surrounding level. Our natural bridge, I conclude, is simply an extreme or abnormal enlargement of such a 'window.' Possibly some water channel may have assisted in the process, but the view does not indicate this, but shows the bridge to be high above the main water course. The dimensions of the bridge, or rather the shape of the space covered by it, are also against this idea, as the ordinary channel cut by a stream through rock is deep and narrow.

ARTHUR WINSLOW.

KANSAS CITY, MO.,
February 25, 1898.

FIFTH ANNUAL RECEPTION AND EXHIBITION OF THE NEW YORK ACADEMY OF SCIENCES.

THE fifth annual reception and exhibition of the New York Academy of Sciences, of which notice has already been made in SCIENCE, was held in the American Museum of Natural History, April 13th and 14th, and proved to be the most satisfactory and successful of all receptions thus far given by the Academy. The number of exhibits was not as great as heretofore, but was arranged to show the progress of the last year more carefully than had been the custom previously. Hence the exhibit, as a whole, was worthy of detailed attention in every department and received such attention from the several thousand people who were present during the two evenings and one afternoon on which the reception was held. Beside the exhibit of progress in some fifteen departments of science, of which more particular mention will follow, the program included an address on the second evening by Professor George E. Hale, of the Yerkes Observatory, on the 'Functions of Large Telescopes,' which will appear in a later number of this JOURNAL. Mr. C. E. Tripler gave several demonstrations of the properties of liquid air to an astonished and appreciative audience. Indeed, liquid air was the exhibit of the reception concerning which the most questions were asked.

It would be difficult to notice in a short account like this all the important exhibits that ought to be mentioned from a scientific standpoint. In fact, each department contained materials which were praised most highly by those qualified to give praise from a scientific standpoint. As one entered the large hall one was greeted with a magnificent display of the astronomical results of the year, including photographs of the moon, stellar spectra, etc., which attracted a great deal of attention from the many astronomers present. On the right was to be seen the equally attractive exhibition of paleontology, including the several fossil reptiles which were unearthed last year by the American Museum of Natural History, and which are the greatest finds in vertebrate paleontology thus far made by this institution in the far West. The other exhibits in the outer hall included chemistry, philology, mineralogy, experimental psychology and ethnology. The exhibit in philology was large and comprehensive, and received a good deal of attention. This is the first time that this department has ever made an exhibit, although there has been a Section of Philology in the Academy for some time. The exhibit in experimental psychology included several instruments for psychological measurements, exhibited by Professors Cattell, Bliss and others. The exhibit in ethnology contained a few of the best results obtained by the Jesup North Pacific Expedition during the last year, and illustrations of symbolism of the Huichol Indians of Mexico. In chemistry, beside the exhibit of liquid air, the representation and processes of dyeing from the Columbia Laboratory, and the more recent results in the artistic coloring of glass from Tiffany & Co., received the most attention. The exhibit in mineralogy was very carefully arranged, and included some very wonderful crystals, and several minerals from Tasmania and New South Wales, exhibited by Dr. A. E. Foote.

In the second hall devoted to the exhibit was found on the right, first, the exhibit in botany, largely devoted to microscopical and other preparations in morphology, and the exhibition of new species and genera from various parts of the United States. Indeed, several hundred feet of wall space were attractively and artistically covered with herbarium specimens illustrating these points. In anatomy the large series of preparations of the anatomy of reptiles exhibited, by the Department of Anatomy of Columbia University, was striking, as showing the latest results in staining, preparation and mounting. An equally attractive exhibit was made in the department of zoology, including the results in insect coalescence, on the several Puget Sound expeditions of Columbia University, and the expedition to Bermuda of the New York University in 1897. On the same side of the hall there was a good-sized exhibit in photography, including an illustration by lantern of colored photography, and the latest papers and developers and their results.

On the other side of the hall, as one entered, was to be seen the large exhibit in geology, in which mention should be made of the clays and other specimens from Europe collected by Dr. Heinrich Ries in his studies of kaolins and clays abroad. The most beautiful exhibit was that of the leucite and trachytic rocks of the Italian peninsula, of Mr. Henry S. Washington, of Locust, N. J.; also photographs and specimens illustrating recent experiments in compression and flowage of marble carried on at the McGill University, Montreal, should be mentioned. The exhibit in physiography included a large number of maps of the United States Geological Survey mounted for physiographic uses, the Harvard Geographical Models, a model of

New York Island to show the topography in 1776 as contrasted with the present, and a model of the Catskills, in which the vertical and horizontal scale being the same, the exact features were reproduced. In the department of physics a number of pieces of apparatus were exhibited from Columbia University, to show the latest advances in laboratory investigations and materials therefor. The stremmatograph, and records of results obtained on the Boston and Albany Railroad, exhibited by Mr. P. H. Dudley, attracted an unusual amount of interest. The last exhibit, at the end of the hall, was in electricity, and included a number of new pieces of apparatus from Columbia University and elsewhere, among which should be mentioned an induction coil with thirty-inch spark, and apparatus illustrating the Marconi system of transmitting signals to a distance without wire.

The amount of interest that has been awakened by the annual receptions and exhibitions in New York City is very large, and has increased greatly within the last year. We all feel that such an exhibit is a most helpful way in which to bring the knowledge of science before the people, and the appreciative interest of the visitors has proved an inspiration even to the most skeptical. The annual exhibition of the Academy has come to be looked upon as one of the scientific events of the year by the inhabitants of New York scientifically interested, and will undoubtedly be repeated each spring indefinitely.

RICHARD E. DODGE.

CURRENT NOTES ON BOTANY.

A NEW PLANT CATALOGUE.

MR. A. A. HELLER, of the University of Minnesota, has compiled what must prove to be a most useful catalogue of the higher plants (Pteridophytes and Spermatophytes) of North America north of Mexico. It is the first attempt at making such a catalogue under the 'Rochester and Madison Rules' and following the Eichler sequence of families, and for this reason is of more than ordinary interest. It is moreover the first catalogue of the plants of North America prepared by a working botanist.

There are 14,534 entries with a few duplicated numbers, which may increase the whole number by fifty or seventy-five more. Of this vast number more than 14,000 are flowering plants proper, there being 263 ferns and fern-allies and 112 gymnosperms. The largest families are Compositæ (exclusive of Cichoriaceæ, 146) with 2149 species; Papilionaceæ 1095, with 129 in the closely related Cæsalpiniaceæ and Mimosaceæ; Gramineæ, 938; Cyperaceæ, 724. The larger genera are *Carex* with 431 species; *Astragalus*, 252; *Eriogonum*, 184; *Aster*, 157; *Erigeron*, 137; *Solidago*, 114. We learn also that there are 15 North American palms, and 210 orchids.

BIBLIOGRAPHICAL DIFFICULTIES IN BOTANY.

DR. E. L. GREENE prints, in a recent number of the *Catholic University Bulletin*, a thoughtful discussion of some of the troubles which confront the systematic botanists. In it he makes some pertinent remarks upon the importance of nomenclatural accuracy in science: "There is, of course, no science without its nomenclature and terminology. And in botany nothing can be done, at least no results of research can be communicated, apart from the names of the plants or groups of plants which have been under investigation. Just as the correct and full and true name of any man is a kind of necessity of his existence as a member of society, so the name of the family, of the genus and of the species to which any tree or shrub or herb belongs is indispensable to a scientific, or, indeed, any kind of understanding and discussion of it."

* * "Botanical nomenclature means, or ought to mean, the same name for the same group of plants, for all botanists of whatever language or nation. This is agreed to by all. And it is in a general way as universally conceded that, under certain limitations, and with important exceptions, the scientific name of every plant species is determined by the principle of priority of publication."

Dr. Greene then states precisely three important and fundamental nomenclatural principles, as follows: "(1) The employment of Latin as the language of plant names; (2) priority of publication, and (3) the binary character of all species names as being made up of a genus name of one term and a species name of one term." A plant is, therefore, to bear the oldest published Latin generic name of one term, combined with its earliest published Latin specific name of one term. These rules, while plain and evidently just, involve many difficulties in their application. Thus it happens that it is often difficult to determine what are the limits of many of the Linnæan genera as given in the 'Species Plantarum' of 1753, on account of the fact that Linnæus often *compiled* without critical examination. In the course of his discussion Dr. Greene suggests the advisability of taking Tournefort's 'Institutiones' of 1700 as the starting point for the genera of plants.

In regard to specific names much confusion has arisen on account of the insufficiency of so many of the Linnæan descriptions, and this can be helped in many cases only by a careful study of the earlier botanical authors, Dodonæus, Ray, Bauhin, Clusius, Plukenet, Micheli, Dillenius, Haller, Le Vaillant and Gronovius. "Just as the master of Latin philology must have close acquaintance with each one of the ancient Latin authors, so should every botanical scholar who would perfectly understand Linnæus be somewhat philologically familiar with every one of those standard pre-Linnæan authors to whose descriptions of plants Linnæus refers us on every page of his."

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

CURRENT NOTES ON PHYSIOGRAPHY.

GEOGRAPHY OF INDIAN TERRITORY.

A THESIS presented to the Department of Geology of Stanford University by N. F. Drake on 'A Geological Reconnaissance of the Coal Fields of the Indian Territory' (Proc. Am. Phil. Soc., XXXVI., 1897, 326-419, map) contains a number of geographical notes on a little known district. The Ouachita mountain system extends into the territory south of the Arkansas and Canadian rivers, repeating the features described in Arkansas by Griswold; sharp monoclinal ridges on close folded structures, and flat-topped mountains, often synclinal in structure, where the folds are more open; all with an east and west trend, and contributing to the western extension of Appalachian-like disturbance and topography, as explained by Branner (*Amer. Jour. Sci.*, *November, 1897*). A plateau with broad uplands and narrow valleys enters from the Ozark region on the northeast as far as the Grand and Arkansas rivers; repeating the features described for Missouri by Marbut (SCIENCE, V., 20), the 'Boston mountains,' a plateau with ragged promontories and outliers presenting the strongest relief in this division. The Great Plains enter from the northwest into the angle between the Grand and Canadian rivers; an extended area of moderate relief, descending gently eastward, and here and there falling in terrace-like escarpments, 50 to 100 feet high, as the harder strata are passed; thus repeating features so well described by the University of Kansas Survey on the North (SCIENCE, V., 945).

SUBMERGED VALLEYS ON THE CALIFORNIA COAST.

A PRELIMINARY paper of 1886 is now followed by a more detailed account of the 'Submerged Valleys of the Coast of California, U. S. A., and of Lower California, Mexico,' by George Davidson (Proc. Cal. Acad. Sci., 3 Ser., Geol., I., 1897, 73–103). Along our Pacific coast the continent descends to depths of 2,000 to 2,700 fathoms within fifty miles from the shore line. There is generally a ten-mile platform sloping out to the 100-fathom contour, after which the descent is relatively sharp. The edge of this platform is broken by twenty-seven 'submerged valleys,' finely illustrated in nine plates where all soundings are shown, so that one may measure the accuracy of the interpolated contours and be convinced not only that the platform is sharply notched where the submerged valleys are drawn, but also that it is essentially continuous elsewhere. The notches are sometimes in line with rivers on the land, as at Monterey and Carmel, but others appear to be entirely independent of existing drainage, as King peak and San Pablo valleys, both of which have to be named after mountains opposite their heads. The curious story is told of a vessel that was lost on the rocky coast fronting King peak; she probably had run in along the axis of the submerged valley and, finding no bottom with the ordinary line, thought she was at a safe distance off shore.

The possibility that certain chasm-like valleys, such as that of Vincente, result from dislocations appears to be excluded by the evenness of the littoral platform on either side of the chasm, but the actual origin of the valleys can hardly be found until they are studied in connection with the structure, form and drainage of the neighboring and still visible land. It is well to guard against the implication that submerged valleys result from 'continental' movements, by remembering that the earth's crust may bend beneath the sea as well as upon the land and that the down-bending and consequent submergence of a coastal belt gives no more warrant of a truly 'continental' movement than does the occurrence of a local inland anticline.

WATER RESOURCES OF INDIANA AND OHIO.

UNDER the above title, F. Leverett, for a number of years engaged on the study of drift deposits in the Ohio Valley, contributes an account of local water supplies, with particular reference to the occurrence of ground water in drift and rock (18th Ann. Rep., U. S. G. S., Pt. IV., 421–559). The essay includes much that is pertinent to these notes, and particular reference should be made to three maps that give sketch contours, rock geology and glacial features of the two States concerned. The last of the three is the best presentation yet published of the marvellously complex drift deposits formed by the great ice lobe from the Erie trough. Nothing could more forcibly illustrate the importance of including some explanatory account of geographical features in the ordinary teaching of geography than the contrasts here brought forward between different areas, according as they have been glaciated or not, or as they are sheeted with the older loess-covered till, the more recent moraine-belted till, or the still younger lake silts. The control of preglacial topography by rock structure and the effect of this topography on the advance of the ice sheets are well exposed; the Bellefonte Devonian outlier, and the Scioto and Miami groups of lobate moraines on either side of it, being manifest illustrations. The hilly uplands or 'knobs' of southern Indiana, determined by outcrops of the lower Carboniferous series, seem to have exerted a similar control over the extent of the earlier ice advance; but

here the confirmatory evidence of moraines is wanting. Remembering that the 'absence of moraines' was one of the arguments against the glacial theory but a few decades ago, this map is very edifying.

THE URAL MOUNTAINS.

ONE of the first contributions to our scientific literature resulting from the International Geological Congress in Russia last summer is by Dr. Persifor Frazer on a 'Geological Section from Moscow to Siberia and Return' (Proc. Acad. Nat. Sci., Phila., 1897, 405–457), in which some interesting geographical features of the Ural mountains are set forth. Approaching this range from the west, there is nowhere presented a bold rugged landscape like that of the Alps or the Caucasus; a gradual ascent leads across the disturbed ancient rocks, generally striking north and south, to the divide; then a moderate descent leads to a lower and open plain, although the disturbance of the rocks continues in full force. Karpinsky is quoted as writing of this plain that, "although its geological structure corresponds with a very complex mountain region, the greater part of it presents an area so flat that the relief is less accidented than that of most of the plains of European Russia;" and the removal of the former mountains is ascribed by the Russian geologist to abrasion by a Tertiary sea, whose sediments stretch into Siberia. From the divide one may look westward and see the ridges separated by longitudinal strike valleys, whose outlet is through transverse gorges to the Russian plains; to the east, one looks across the old mountain plain toward the boundless, lake-dotted steppes of Siberia. Deep lakes, with ragged shores and many islands, as well as numerous swamps, abound on the old mountain plain; their drainage is eastward by streams that have cut gorges in their middle course and opened broad-floored valleys farther forward. In the absence of all evidence of glacial action, several hypotheses are offered to account for the lakes.

W. M. DAVIS.

NOTES ON INORGANIC CHEMISTRY.

IN the *Proceedings* of the Chemical Society (London) T. C. Porter has a note on the volatility of sulfur. When heated to 100° in a vacuum tube sulfur sublimes with some degree of rapidity, the sublimate consisting of very pale yellow drops, which remain unchanged for several days; at ordinary temperatures even in a good vacuum there is no perceptible sublimate, even in the course of a year. In commenting on the paper Professor Dewar said that if the vacua are cooled with liquid air or oxygen a visible distillation of sulfur takes place even at ordinary temperatures.

AT the meeting recorded in the above *Proceedings* Professor Bohnslav Brauner, of Prague, was present for the purpose of reading four papers on the chemistry of the rare earths. The first two papers were on thorium, describing his method of purification as ammonium thoroxalate, and atomic weight determinations leading to the figure 232.42; agreeing with the work of Krüss and Nilson (232.45), but lower than that of Cleve (234.5). The third paper was on the compound nature of cerium, in which the author holds that some unknown element, of lower atomic weight (perhaps about 110) and with no characteristic spark spectrum, is present in the cerium from cerite. The last paper on praseodymium and neodymium is chiefly a study of the compounds of praseodymium. From experiments to determine whether the higher oxid PrO_2 belongs to the type of PbO_2 or BaO_2 the author concludes that it is "an oxid of a new kind, belonging simultaneously to the ozonic oxids of the water type, and to the antozonic oxids of the hydrogen peroxid type; it is, in fact, the

missing link between these two hitherto entirely different types of peroxids, its active oxygen being at the same time both entirely ozonic and entirely antozonic." He believes both praseodymium and neodymium may be further split up and will give when pure for their highest oxids the formulæ Pr_2O_5 and Nd_2O_6; hence, he would arrange the eighth series of the periodic system as follows:

I.	II.	III.	IV.	V.	VI.
Cs	Ba	La	Ce	Pr	Nd
133	137.4	138.2	139.7	141	143.6

SOME months ago a petition, signed by several hundred members of the Chemical Society (London), was presented to the Council, asking for an amendment to the By-Laws so that members could vote for the officers at the annual meeting by proxy or by mail. As the number of members who can be present at this meeting is not large, a comparatively small proportion of the total membership practically controls the offices. The Council declined to take any action owing to the fact that such a By-Law would conflict with the charter. An effort was then made to have the Council seek an amendment to the charter, which was declined. A petition was then presented to have the Council take action to obtain the views of the members by taking a mail vote on the question: "Are you in favor of the proposal that a supplemental charter should be applied for to the Privy Council so as to enable Fellows to vote at the annual election of the officers by post or proxy?" This also the Council declines to do. The desire of the petitioners is so manifestly just that it is hardly probable the matter will be allowed to rest at this point, but it is to be greatly hoped that the usefulness of the Society will not be impaired by dissensions.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

THE third regular semi-annual meeting of the Chicago Section of the American Mathematical Society was held at the University of Chicago, on Saturday, April 9, 1898, with the following program:

1. A triangle related to Nagel's triangle. PROFESSOR ROBERT J. ALEY, Indiana University.
2. The ellipsograph of Proclus and its inverse (illustrated by models). DR. E. M. BLAKE, Purdue University.
3. The structure of the hypo-abelian groups. DR. L. E. DICKSON, University of California.
4. I. Quaternion notes. II. Introduction to the theory of functions of a quaternion or a vector variable. DR. SHUNKICHI KIMURA, Sendai, Japan.
5. On the most general form of the inner potential consistent with the complete integration of the differential equations of motion of a free system of two bodies. DR. KURT LAVES, the University of Chicago.
6. Concerning the case where a linear substitution group of finite order in n variables breaks up into groups in a lower number of variables. ASSOCIATE PROFESSOR H. MASCHKE, the University of Chicago.
7. On the roots of a determinantal equation. PROFESSOR W. H. METZLER, Syracuse University.
8. A two-parameter class of solvable quintics in which the rational relations amongst the roots by threes are independent of the parameters (preliminary communication). HEAD PROFESSOR E. H. MOORE, the University of Chicago.
9. Dual algebras. PROFESSOR JAMES BYRNIE SHAW, Illinois College.

At the opening of the afternoon session, in response to the invitation of the program committee, Professor Michelson, of the University Chicago, made a very interesting exhibition of the theory and of the workings of the new 'Harmonic Analyser' to the members of the Society.

PROPERTIES OF THE X-RAYS.

PROFESSOR RÖNTGEN has made to the Berlin Academy of Sciences a third communication on the X-rays. A summary in the *Electrical World* states that if an opaque plate is placed between the tubes and the screen, covering the whole of the latter, some fluorescence will still be seen even when the plate is directly on the screen;

he showed that this is due to the fact that the air around the tube gives forth X-rays; if our eyes were sensitive to these rays, as they are to light, then such a tube would be like a light in a room filled with smoke. The brightness of a screen illuminated with rapidly intermittent rays depends on a number of properties which he enumerates. The X-rays from a platinum focus plate which are most active for showing images are those which leave the plate at the greatest angle, but not much greater than 80°; thick plates have a relatively larger transparency than thin ones, that is, the specific transparency of a body is greater the thicker the body; when two plates of different bodies are equally transparent they need not necessarily be so when similarly increased in thickness; the relative thickness of two equally transparent plates of different materials is dependent on the material and its thickness, through which the rays have passed before they reach those plates; the same body has different transparencies with different tubes, 'soft tubes' being those requiring a small potential and 'hard tubes' those requiring a high one; he states that all bodies are more transparent for rays from hard tubes than from soft ones, and in obtaining images this must therefore be considered; the quality of the rays from the same tube depends on: The way in which the interrupter works; the Deprez form acts more regularly, while the Foucault form utilizes the primary current better; on the spark length in series with the tube; on the insertion of a Tesla transformer; on the vacuum; on other processes in the tube which are not yet fully investigated. A spark gap in series acts like a Tesla transformer, both giving more intense rays which are less easily absorbed; the smallest pressure at which X-rays are produced is very likely below 0.0002 mm. of mercury. The hardening of a tube is not produced only by continuing the exhaustion; to soften a hard tube, air may be admitted; it may be warmed, or the current reversed, or very strong discharges sent through it, but the latter generally changes the character of the tube; good results were produced with a tube containing a piece of charcoal of linden wood. The composition of the rays from a platinum anode depends largely on the element in the current; the quality of the rays does not change with changes of the primary current, or at least very little, but the intensity is proportional to the strength of the primary current between certain limits. He draws the following conclusions: The radiation consists of a mixture of rays of different intensity and absorbability; the composition depends greatly on the time element in the current; the rays produced by the absorption of bodies are different for different bodies; as X-rays are produced by cathode rays, and as both have common properties, it is probable that both processes are of the same nature. If two screens are illuminated with two tubes of different hardness, the illumination being made equal, and if then replaced by photographic plates, the one illuminated by the harder tube will be blackened much less than the other; rays which produce equal fluorescence can be photographically quite different; the usual photographic plates are very transparent for X-rays; in a pile of ninety-six filaments exposed for five minutes the last one showed photographic action. That the eye is not entirely passive to X-rays is shown by an experiment; in looking at a slit in a metal screen with the closed eye covered with a black cloth and by moving the head, a very weakly illuminated slit will be noticed; this may be explained by assuming that fluorescence is produced on the retina.

'CHRISTIAN SCIENCE.'

PROFESSOR J. MARK BALDWIN has, in the press of the Appletons, a little book called 'The Story of the Mind' (Useful Story Series). He allows us to print, from the proofs, the following short passage, which may have some interest to our readers in view of certain recent discussions by committees of the Massachusetts and New York Legislatures:

"All mental diseases involve disease of the brain, and can be cured only as the brain is cured. It does not follow, of course, that in some cases treatment by mental agencies, such as suggestion, the arousing of expectation, faith, etc., may not be more helpful here than in troubles which do not involve the mind, provided these agencies be wisely employed; but yet the

end to be attained is a physical as well as a mental cure, and the means, in the present state of knowledge, at any rate, are mainly physical means. The psychologist knows practically nothing about the laws which govern the influence of mind on body. The principle of suggestion is so obscure in its concrete working that the most practiced and best-informed operators find it impossible to control its use or to predict its results. To give countenance, in this state of things, to any pretended system or practice of mind-cure, Christian science, spiritual healing, etc., which leads to the neglect of ordinary medical treatment, is to discredit the legitimate practice of medicine and to let loose an enemy dangerous to the public health.

"Moreover, such things produce a form of hysterical subjectivism which destroys sound judgment and dissolves the sense of reality which it has taken modern science many generations to build up. Science has all along had to combat such wresting of its more obscure and unexplained facts into alliance with the ends of practical quackery, fraud and superstition; and psychologists need just now to be especially alive to their duty of combating the forms of this alliance which arise when the new results of psychology are so used, whether it be to supplement the inadequate evidence of 'thought transference,' to support the claims of spiritualism, or to justify, in the name of 'personal liberty,' the substitution of a 'healer' for the trained physician. The parent who allows his child to die under the care of a 'Christian science healer,' is as much a criminal from neglect as the one who, going but of step further in precisely the same direction, brings his child to starvation on a diet of faith. In France and Russia experimenting in hypnotism on well persons has been restricted by law to licensed experts; what, compared with that, shall we think of this wholly amateurish experimenting with the diseased? Let the 'healer' heal all he can, but don't let him experiment, to the extremity of life and death, with the credulity and superstition of the people who think one 'doctor' is as good as another."

GENERAL.

AT a stated meeting of the Board of Overseers of Harvard College on April 13th it was voted to concur with the President and Fellows in their votes appointing Alexander Agassiz, LL.D., Director of the Museum of Comparative Zoology, as professor emeritus.

MAJOR JIRARD and Medical Director Tryon have been in attendance at the Congress of Hygiene, Madrid, as delegates from the medical departments of the army and navy of the United States.

THE Council of the Linnæan Society, London, has decided to award the Society's gold medal this year to G. C. Wollich, in recognition of his investigation of the biological conditions of the deep sea.

WE regret to record the death, on April 17th, of Dr. Jules Marcou, the geologist and a writer on a wide range of scientific subjects. Dr. Marcou was born in Salins, France, seventy-five years ago.

SIR WILLIAM TURNER, F. R. S, professor of anatomy at Edinburgh, has been elected a corresponding member of the Berlin Academy of Sciences.

SIR SAMUEL WILKES has been re-elected President of the Royal College of Physicians, London.

THE French Minister of Public Instruction has announced that the prize of the value of $1,000, founded by M. Angrand for a work on American archæology, has been awarded to Dr. Hamy for a study of The Gallery of American Antiquities in the Museum of Trocadéro.

THE Municipal Council of Paris has authorized the erection of the monument to Charcot by Falguière on the Place de l'hospice de la Salpêtrière.

M. FELIX FAURE, President of the French Republic, has consented to preside at the first session of the International Medical Congress to be held in Paris in 1900.

PROFESSOR FREDERICK STARR, of the University of Chicago, has lately returned from a trip to Mexico, in which he began a study of the physical types of the southern Mexicans. Four tribes were visited—Otomi, Tarascan, Tlaxcalan, Aztec. Careful descriptive notes, measurements and photographs were made. One hundred men and twenty-five women, in each tribe, were examined. A series of fourteen

plaster busts was made. Collections of dress, implements and weapons were secured. The work will be continued next winter among the tribes of Oaxaca and Chiapas, the southernmost States of the Republic. The results so far gained will probably be presented at the next meeting of the A. A. A. S. A somewhat careful examination was also made of the ruins of La Quemada, in the State of Zacatecas. The curious and ancient picture record of the Conquest preserved at Cuablhtlautzineo was photographed and will soon be published. A large collection of objects illustrating the folk-lore of the half-breed Mexicans was secured; this is to belong to the English Folk-Lore Society. The catalogue of this collection, with descriptive notes, is to be printed as one of the Society's regular publications. Lastly, some investigation was made of hexdactyly and other abnormal conditions, some interesting molds and data being gathered.

PROFESSOR LAWRENCE BRUNER, of the University of Nebraska, returned, on April 6th, from the Argentine Republic, where he had been engaged for year in studying the habits of a devastating locust. His report is now in press and is expected to appear soon.

THE Royal Society will hold its first Conversazione this year on Wednesday, May 11th.

A 'JARDIN DE KEW' is to be established in the neighborhood of Nantes by a rich citizen of that town. The new botanical garden will be planned on the same lines as the Royal Gardens at Kew, and special attention will be given to the cultivation of plants useful in French colonies. It is hoped that the garden will eventually do for French colonial possessions what Kew does for British colonies.

A COURSE of ten popular lectures on Amphibians and Reptiles will be delivered in the lecture room in the Zoological Society of London Gardens, Regent's Park, on Thursdays, at 5 p. m., commencing April 21st, by Mr. F. E. Beddard, M.A., F.R.S., Prosector to the Society.

A SECTION of ornithology has been formed in the California Academy of Sciences, with Mr. L. M. Loomis as President.

THE late Mr. G. C. Dennis has bequeathed his entomological collection to the Yorkshire Philosophical Society.

THE United States Civil Service Commission calls attention to the examination which will be held on May 6, 1898, at any place where the Commission has a competent board of examiners, for establishing a register from which the position of Chief of Division of Library and Archives, United States Coast and Geodetic Survey, Treasury Department, at a salary of $1,800 per annum, may be filled. This is a very important and responsible position, and the Commission is anxious that the competition shall be as extensive as possible. On April 25th an examination will be held for a teacher of manual training in the Indian service, with a salary of $720.

THE executors of the late Baron Ferdinand von Müller, Government Botanist of Victoria, are collecting money to erect a monument over his grave in the St. Kildare Cemetery at Melbourne. Over one hundred subscriptions have already been received, including donations from the London Royal Geographical Society and other scientific associations. We do not notice in the list any subscriptions from America, and it is to be hoped that these will be supplied before the subscription is closed. Letters should be addressed to Rev. W. Potter, 'Vonmueller,' Arnold street, South Yarra, Melbourne, Australia.

WE are also informed that Baron von Müller's supplemental volume on the *Flora Australiensis*, upon which he had worked for years and was preparing for the press at the time of his death, together with two volumes on his administration as Director of the Botanical Gardens, embracing a biography and complete bibliography of his writings, are to be published. His executors will feel favored by the loan of any of his letters, or the communication of incidents in the Baron's life which his friends deem to be worthy of notice in his biography. Communications on this subject should also be addressed to the Rev. W. Potter.

To commemorate the dedication of the new laboratory of chemistry of the University at Leipzig, its Director, Professor Ostwald, has collected the researches carried out in the old

laboratory by him and his students during the ten years from 1886 to 1896. The four large volumes resulting are published by Herr Engelmann, Leipzig.

The long-looked-for first volume of the 'Phytogeography of Nebraska,' by Messrs. Pound and Clements, was received from the printer by the authorities of the University of Nebraska on the 7th of the current month.

The April number of *The Auk* contains the programs of the annual meetings of the Delaware Valley Ornithological Club and of the United Ornithologists of Maine. The former Club met at the Academy of Natural Sciences in Philadelphia, with 34 members in attendance. Mr. I. Norris DeHaven and Mr. Charles J. Rhodes, Secretary. The United Ornithologists of Maine held their second annual meeting in the rooms of the Portland Society of Natural History on December 31st and January 1st. Mr. Ora W. Knight was elected President and Mr. L. W. Robbins Secretary. The *Maine Sportsman* is the official organ of the Society and publishes full accounts of the the meetings and many of the papers.

The following bill, introduced by Senator George F. Hoar, has already passed the United States Senate, though it is rumored that certain importers and milliners have held a meeting in New York, and propose to send a powerful lobby to Washington to defeat the bill in the House. There is, however, some probability that the bill will pass the House if humane persons and those interested in the protection of our native animals will immediately call the matter to the attention of their Representatives.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the importation into the United States of birds, feathers, or parts of birds for ornamental purposes, be, and the same is hereby prohibited; Provided, however, That nothing herein contained shall be construed as prohibiting the importation of birds for museums, zoological gardens, or scientific collections, or the importation of living birds or of feathers taken from living birds without injury to the bird. The Secretary of the Treasury is hereby authorized to make regulations for carrying into effect the provisions of this section.

"Sec. 2. That the transportation of birds, feathers, or parts of birds, to be used or sold, from any State or Territory of the United States to or through any other State or Territory of the United States, is hereby prohibited. Whoever shall violate the provisions of this section shall, upon conviction in the district where the offense shall have been committed, be punished for each such offense by a fine of fifty dollars.

"Sec. 3. That the sale, keeping, or offering for sale, within any Territory of the United States, or within the District of Columbia, of birds, feathers, or parts of birds, for ornamental purposes, except such as are excepted in the first section of the Act, be, and the same is hereby prohibited. Whoever shall violate the provisions of this section shall, upon conviction, be punished for each such offense by a fine of fifty dollars."

The Massachusetts Audubon Society held a meeting in Association Hall, Boston, on April 14th, to protest against the slaughter of birds for millinery purposes. Professor C. S. Minot presided and made an address, which was followed by addresses by Mrs. Alice Freeman Palmer and by Mr. Frank M. Chapman, of the American Museum of Natural History, New York.

Arrangements for the excursions of the Appalachian Mountain Club of Boston for the present year are not yet completed, but there is a strong probability that the following program will be carried out: May 27th–June 1st, Hoosac Tunnel Station. The intention is to visit Greylock, and Haystack in Wilmington, Vt. June 16th–19th, Warwick and Mt. Grace. June 17th, harbor excursion. July 1st–11th, the Field Meeting will, in all probability, be held in the Adirondacks. August, there will be a camping party at a lake. September 2d–6th, Camden, Me., and its mountains will be visited. October, Dixville Notch (a week or ten days).

Captain Jacques read, on March 31st, an interesting paper before the British Institution of Naval Architects on 'Submarine Torpedo Boats,' in which he criticised the contemporary form of torpedo boat, asserting its unreliability and general flimsiness, and gave as his opinion that it is often more dangerous to its own crew than to the enemy. He considers the submarine torpedo boat the coming

form of this most modern of naval weapons and points to its complete invisibility in action, its power of carrying armor if desired, its perfect liberty of movement under water and safety and certainty in placing its torpedo, as well as the comfort and safety of its own crew, as considerations that must inevitably ultimately give it the leading place in a naval establishment, and especially for one like that of the United States, planned mainly for defense.

THE commercial reporters of *Industries and Iron* state that Messrs. L. Lowe & Co., of Berlin, Germany, manufacturers of electric supplies, have ordered from the United States an Allis-engine of 900 h. p. to furnish light and power at their works. The Société des Railways économiques de Liége, Seraing et Extensions, and the Compagnie générale des Railways à Voie étroite, have sent to the United States for a complete electrical equipment of the Westinghouse Company's make. A large business has been secured by builders of heavy machinery in the United States, for delivery in Great Britain, and it now seems probable that they may find a profitable and an extensive market on the Continent of Europe. The manufacturers of Europe are, however, reported to have good business, and competition from this side of the ocean has not produced any sensible effect in the direction of transfer of trade to this country.

IT will be remembered that the Paris International Meteorological Conference of 1896 appointed a permanent Committee on Terrestrial Magnetism and Atmospheric Electricity, and submitted to it a number of questions for report. In order that these questions may be well discussed, says *Nature*, it has been decided to hold an international conference on terrestrial magnetism and atmospheric electricity in connection with the forthcoming meeting of the British Association at Bristol, which will begin on September 7th. Letters of invitation are being sent out by the Committee; and all foreigners who propose to attend the conference may obtain tickets of membership of the British Association, free of charge, on application to the Assistant General Secretary of the Association. Among the subjects to be discussed are: The calculation of monthly means with and without taking disturbed days into account; the publication of the monthly means of the components X, Y, Z, and the differences $\triangle X$, $\triangle Y$, $\triangle Z$, of the monthly means from the preceding means; the establishment of temporary observatories, especially in tropical countries; and the relative advantages of long and short magnets. The decisions of the conference upon these questions will be reported direct to the International Meteorological Conference. But though the first business of the conference will be to report upon the questions submitted to them, papers and communications on other subjects connected with terrestrial magnetism and atmospheric electricity are also invited. It is desired that such papers be sent to the Committee some time before the opening of the British Association meeting.

UNIVERSITY AND EDUCATIONAL NEWS.

AT a meeting of the Board of Trustees of Cornell University on April 14th it was decided to establish a medical department to be located in New York City. The faculty will consist chiefly of the members of the faculty of the New York University Medical College who have been dissatisfied with the relations between the College and the University. The new medical college, like other departments of Cornell University, will be open to women on the same terms as to men, and students appointed to State scholarships by the Superintendent of Public Instruction may obtain free tuition from Cornell University in medicine hereafter, as they now obtain it in art, law, engineering, architecture, etc. It appears that Colonel Oliver H. Payne has given $500,000 toward an endowment and that buildings will be erected at once. The College will be opened next year with Dr. W. M. Polk as Director.

AT the same meeting Dr. B. E. Fernow, Chief of the Division of Forestry, United States Department of Agriculture, was elected Director of the College of Forestry, recently established by an appropriation from the Legislature of the State of New York.

PROFESSOR EARL BARNES, lately professor of education in Stanford University, will, it is

said, on his return from Europe, occupy a chair in the newly-established School of Pedagogy in Cornell University, devoting himself chiefly to problems of child-study.

AT the meeting of the Board of Regents of the University of California on April 12th Mrs. Phœbe Hearst offered to construct and equip at her expense a building for the College of Mines.

MCGILL UNIVERSITY has suffered severe losses in the resignation of Professor Hugh L. Callendar, of the chair of physics, and Professor C. A. Carus-Wilson, of the chair of electrical engineering. Professor Callendar has been appointed to the chair of physics in University College, London, vacated by the resignation of Professor Carey Foster.

THE summer session of the University of Nebraska opens on June 6th and closes July 16th. It is to take the place of the University Summer School, hitherto maintained for from two to four weeks each year. Regular University work will be offered in eighteen departments and special work in six or seven more. It is the expectation of the University authorities ultimately to develop the summer session so as to afford opportunities for vacation work along nearly all lines of University study. The sciences now offered are botany, chemistry, entomology, geology, physics and zoology.

DISCUSSION AND CORRESPONDENCE.

ISOLATION AND SELECTION.

TO THE EDITOR OF SCIENCE: Will you permit me to use your pages for protesting against the indiscriminate use of the word 'Selection' by writers on Organic Evolution. Selection means the act of picking out certain objects from a number of others, and it implies that these objects are chosen for some reason or other. Now Selection, by itself, can never originate a new variety or a new species. To do this it must always act in conjunction with the isolation of the selected individuals.

'Artificial Selection,' by which breeders form new races of domesticated animals, consists of two distinct processes. The breeder first selects his animals and then isolates them from those which have not been selected. It is isolation of the individuals which produces the new race; selection merely determines the direction the new race is to take. On the other hand, Isolation is capable of originating new species without the cooperation of Selection. For, if a few individuals of a species become isolated from the others by some physical agency, such as a flood, a drought or a hurricane, and happen to have some peculiarity or variation different from the average of the species, that variation will now have a special chance of being propagated and probably intensified, although the original parents were not selected in any way. The one factor common to all cases of organic evolution is Isolation, and consequently it must be considered as the most important factor.

I have summarized the different ways in which Isolation can be brought about in a paper in *Natural Science* for October, 1897, to which I may be allowed to refer any of your readers who are interested in the matter. Selection implies the action of a Selector outside of the individuals which are selected, whether that Selector be, or be not, conscious of what he is doing ; this is the Artificial Selection of Darwin. Natural Selection is not truly selection, for the individuals can hardly be said to select themselves by their superior strength, cunning, or what not. Still the term has become so firmly established that it can well be allowed to pass, if used only in Darwin's sense of advantage gained in the struggle for existence, either by the individual or by the species. It is, certainly, quite as good a term as Organic Selection, and has the advantage of having been proposed by the founder of the doctrine of evolution.

I quite agree with Professor Mark Baldwin and others that Determinate Evolution is the only explanation of the main facts of organic progress. But alongside of this Determinate Evolution a large amount of Indeterminate Evolution has also been going on. For example, although Humming Birds and Diatoms, as groups, are the product of Determinate Evolution, I cannot believe that all the specific characters of the various Humming Birds, or the specific and generic characters of the various Diatoms, are due to the same agency, for they show no definite tendency in any direction, but merely variety.

Now, while we think of all evolution as the result of some kind or other of Selection this remains an enigma. But when we distinguish between the two processes of Isolation and Selection and assign to each its true function we get at once the explanation of our difficulty. Determinate Evolution is due to the combined action of Isolation and Selection. Indeterminate Evolution is due to the action of Isolation alone.

I think that Darwin had this distinction in his mind when he said that Natural Selection was the chief, but not the only, cause of the origin of species. At any rate, it seems to me to embody the whole truth, although Darwin's attention was chiefly devoted to establishing the cause of Determinate Evolution by, what I hope we may still call, Natural Selection.

F. W. HUTTON.

CHRISTCHURCH, NEW ZEALAND, March 1, 1898.

MODERN STRATIGRAPHICAL NOMENCLATURE.

ONE of the most noteworthy features connected with every one of the various branches of the rapidly expanding science of modern geology is a widespread and oft-deplored change in terminology. Old names are discarded, the meanings of others are altered, and a host of apparently useless new ones are proposed.

In no department has the coining of new names gone on more vigorously than in stratigraphical geology. The reason is to be found partly in the naturally favorable conditions that prevail in the field, but largely in the change of base that this branch of science has undergone in late years.

The fundamental conception of the geological formation, whether large or small, whether a great series or a single bed, is a sharply defined 'geological unit' instead of a vaguely bounded 'group' of layers. The former is now clearly distinguished by strictly physical characters that are inherently the direct outgrowth of the actual conditions giving rise to the formations. The latter have been too often based upon trivial or accidental features that are relatively unimportant as critical criteria, either in correlation or classification.

The principle underlying the recent change in the method of naming geological formations gives to each stratigraphical unit a special geographical designation taken from some prominent town, watercourse, or feature of relief, within the boundaries of the formation and where the latter is typically or unusually well shown. As thus established, the formation is a well-defined and independent unit, having a definite position in space, and always an exact relative place in the geological scale, no matter how the latter may be changed afterwards or what method of classification is followed. This definite stratigraphical unit contrasts strangely with the unwieldy, ill-defined and usually little understood large 'group' of the past, the very name of which commonly indicated either a lack of exact knowledge of itself, or a covering-up of almost total ignorance regarding its real affinities.

To be sure, the nomenclature in the field of geology has been greatly increased, even enormously enlarged, by the introduction of the plan. The former list of names numbered only two or three score or so—names of the smallest subdivisions that went to make up the general geological column. The names of the new list run up into the hundreds or even thousands, are different in every region, and additions are constantly being received.

Against this copious multiplication of geological names protests long and loud have gone up these several years past. Still, from time to time, the protestations continue to be uttered. Curiously enough, the struggle, if such it might be called, has been largely reduced to a clash between the practical field geologists on the one hand and on the other the laboratory workers, those especially interested in some particular and limited phase of geology, and the paleontologists who see, in the new scheme, their standard classification scattered to the four corners of the earth and their usefulness in the domains of geology diminished. And the former have manifestly won.

When, a decade and a-half ago, various geological surveys in this country were established or reorganized those intrusted with the work soon found that if speedy and exact results were to be secured—substantial data upon which all other workers could easily build—

something else must be devised than the existing cumbersome and unsatisfactory scheme of vaguely defined geological formations, having no comparable limits in the different geological provinces and even diverse values in the same province, some plan that must be natural and at the same time elastic. Practical experience in the field and the demands of the times soon pointed out a feasible scheme. So well has it served the purpose, and so readily adaptable is it to the changing conditions met with on all sides and to all the unforeseen exigencies continually arising, that it has brought under its standard nearly every practical field geologist.

The present method of designating geological formations by geographical names certainly does greatly expand the nomenclature at times seemingly to a burdensome extent. This appears to be the only objection that has been urged against the plan that might call for notice. Yet, to all except those who do not wish to go beyond the ordinary text-book in geological work, even this seems hardly worthy of special argument, since it is offset by so many manifest advantages.

It may be truly said that no greater boon to the working, as well as to the theoretical, geologist has been devised. Incorporated in the new plan are practically all of the salient good features of the old method, while none of the many objectionable ones are retained. Since its adoption a vast mass of exact information has been obtained that was previously unthought of—information that is in shape to be always used, without the necessity of going all over the ground again; the other departments of geology have been greatly aided, and stratigraphical geology itself has been capable of making greater real progress in the one short decade that has elapsed since the method came into use than in all time previous. In the same short period more has been learned about the real nature of sedimentation, the actual relations existing between different rock formations and the structure of the layered cuticle of the globe, than was possible before. In fact, a rational basis for geological correlation and a genetic classification of formations has been found.

The real meaning, then, of the multitude of new titles that has recently made its appearance in the literature of stratigraphy is the practical adoption of more refined methods of geological work, the provision of means for the collection of more exact geological data and the grasping of more rational conceptions regarding geological correlation and classification.

CHARLES R. KEYES.

SCIENTIFIC LITERATURE.

Die Farnkräuter der Erde. By H. CHRIST. Jena, Gustav Fischer. 1897. Mit 291 Abbildungen. 8vo. Pp. 388. 12 M.

In the preparation of such a work as the above one is expected either to have in mind the filling of a felt want, or at least to furnish a sufficient reason for the expenditure of so much energy. Neither of these seems to have been considered in the present case, if we judge of the work by the test of completeness which the title would lead us to expect. The purpose of the work seems to be the presentation of the general systematic relations of the genera and characteristic species of ferns, without attempting completeness either in the flora of a given region or the full quota of species of any particular group. As a manual for the identification of species its value can only be slight, as it is most likely to be deficient at the point where it is most needed, for usually there is no suggestion whatever of the nature, distribution or number of the allied species, and the specific descriptions that are given are not uniformly full, many of them being very incomplete. The work will be useful within narrow limits, however, particularly among florists and those to whom scientific accuracy is not so uniformly important. It describes more or less completely 1154 species of ferns, which, at a moderate estimate, cannot much exceed one-third of the known species of the world.

The system of classification is not strikingly novel, following in the main that of Mettenius and Prantl. While the number of recognized genera (99) is considerably larger than that recognized at Kew, which has been followed in this country, it will by no means satisfy those who regard genera, among ferns as elsewhere, as natural groups of organisms closely connected in habit and other biological characters, instead of artificial groups thrown together for conven-

ience according to the presence or absence of some unimportant structure. Presl, who was one of the first to recognize natural divisions among the ferns, gave us 230 genera; John Smith, with the advantage of the Kew collection and the largest number of species anywhere in cultivation, only reduced this number to 220; while Fee, the illustrious French pteridologist, recognized 181, and Moore a little later 177. The Kew authorities recognize only 78 including recent additions.

The system followed in the present work can be best judged perhaps by the following outline of its main features:

LEPTOSPORANGIATÆ.

(*Polyangia.*)

Hymenophyllaceæ.
Polypodiaceæ.
  Acrosticheæ.
  Vittarieæ.
  Gymnogrammeæ.
  Polypodieæ.
  Pterideæ.
  Aspleniaceæ (*sic*).
  Aspidiaceæ (*sic*).
  Davalliaceæ (*sic*).
Cyatheaceæ.
Osmundaceæ.

(*Oligangia.*)

Matoniaceæ.
Gleicheniaceæ.

(*Monangia.*)

Schizæaceæ.
Parkeriaceæ.

EUSPORANGIATÆ.

Marattiaceæ.
Ophioglossaceæ.

Concerning the arrangement of families there would probably be little difference of opinion except that from an evolutionary standpoint the order should be inverted and the position of the Hymenophyllaceæ would be called in question. The tribes of the Polypodiaceæ will permit more diversity of opinion. Among the good points to be noted are the removal of *Notholæna* (wrongly printed *Nothochlæna*) to the Pterideæ, where it stands next to its close ally, *Cheilanthes;* the removal of *Lindsaya*, *Nephrolepis* and *Loxsoma*, to the Davallieæ; also the formation of distinct families for the aberrant *Matonia* and *Ceratopteris*. The separation of the unique *Platycerium* from the Acrosticheæ is well timed, but it finds a resting place just as unsatisfactory next to *Polypodium* and always will be a migrant until it is placed in a distinct family of which it is worthy on account of its unique characters.

The divisions of genera are interesting, but exceedingly unequal. *Acrostichum* as recognized by Baker here appears under seven or eight genera, but the equally composite *Gymnogramme* is grouped under only three generic names, though some of its species are relegated to *Polypodium* and *Phegopteris*. *Hemidictyon*, *Ceterach*, *Diplazium* and *Athyrium* (the latter including *A. filix-fœmina*) are separated from *Asplenium*, while the equally distinct *Thamnopteris* (*A. nidus*) and *Darea* are still left in the genus, and the more distinct *Camptosorus* and *Schaffneria* are still left in the same genus as *Scolopendrium*. *Struthiopteris* is very properly separated from *Onoclea*, and *Cibotium* and *Dennstedtia* from *Dicksonia*, though in each case there are complications of nomenclature that will demand a later settlement. Both *Polystichum* and *Nephrodium* are united under *Aspidium* and *Fadyenia* is also included, contrary even to the conservative Kew practice. We are still very far from a natural segregation of the genera of ferns.

The recognition of species, especially those of American origin, is exceedingly faulty. The combination of *Notholæna candida*, *N. Hookeri* and *N. cretacea* into one species is no less notorious than the reduction of *Aspidium Goldieanum* and *A. marginale* to varieties of *A. filix-Hymas*. Quite a number of our American species appear under new names, which will be a new source of grief to conservative botanists, who are troubled because names will change with the advance of investigation. Among these not already mentioned we note:

Chrysodium aureum instead of *Acrostichum aureum*.

Neurodium lanceolatum instead of *Tænitis lanceolata*.

Blechnum spicant instead of *Lomaria spicant*.

Dennstedtia punctiloba instead of *Dicksonia punctiloba*.

The work is illustrated by 291 cuts, which, if not elegant, are mostly sufficiently accurate, and characteristic of the species indicated, to be of value; many of them are original. Two or three new species appear in the work for the first time.

LUCIEN M. UNDERWOOD.

The Calorific Power of Fuels. By HERMAN POOLE, F.C.S., etc. New York, J. Wiley & Sons; London, Chapman & Hall. 1898. 8vo. Pp. xv + 255.

The importance of a work on this subject is to-day vastly more evident, and is very much greater than before the days of scientific discussion, investigation and experimental researches in connection with the processes of modern engineering in the department of heat production and utilization. The extensive application of scientific methods by the engineer in his steam engine and boiler trials, and in a thousand other lines of professional work, also makes the subject and such compilation of facts and data peculiarly important. A work specially devoted to this subject thus assumes rare value.

This treatise is based upon M. Scheurer-Kestner's *Pouvoir calorifique des combustibles* and has been worked into a shape which adapts it to our own data and methods and includes later developments both of method and of apparatus. It gives us an excellent general discussion of the calorimetric principles and of the calorimetric apparatus now available for use by the chemist and by the engineer, and, with especial fullness, all of those found helpful in commercial work.

The fuels are described at considerable length and their heating powers given as computed from their composition and checked by direct calorimetric measurement. The report of the committee of the American Society of Mechanical Engineers on exact methods of steam boiler trial is introduced, and a large quantity of data and an excellent bibliography are appended, the latter including numerous and helpful references to the files of scientific journals. The 'Fuel Table,' in which are given the composition and the calorific power of the fuels of the world, is the most extensive yet produced and is extremely interesting and valuable.

The book is well up to date and includes descriptions of the latest calorimeters, as Berthelot's, Mahler's Barrus' and Carpenter's, gives Ringelmann's 'smoke scale,' Kent's revision of 'Johnson's Report on Coals,' and other no less important recent contributions to the literature of the subject.

The book is one which is likely to find its way into the library of all chemists and of all engineers having to do with applications of the calorific power of fuels. It is well written, well published and of moderate cost.

R. H. THURSTON.

SCIENTIFIC JOURNALS.

The Journal of Physical Chemistry. The January number begins the second volume of this journal. The opening article is the first part of an extensive paper 'On the General Problem of Chemical Statics:' by P. DUHEM, Professor of Theoretical Physics at Bordeaux. The paper is "a commentary on and a complement to the celebrated memoir of J. Willard Gibbs, 'On the Equilibrium of Heterogeneous Substances.'" The second article, 'Fractional Crystallization:' by C. A. SOCH, is a contribution to the theory of separations by fractional crystallization. 'Distribution of Mercuric Chlorid between Toluene and Water:' by OLIVER W. BROWN, completes the original matter. Several pages are devoted to book reviews. The department of reviews of the journal literature of physical chemistry is very full and critical.

February. 'Solutions of Silicates of the Alkalies:' by LOUIS KAHLENBERG and AZARIAH T. LINCOLN. From freezing point and conductivity determinations of solutions of the silicates of sodium, potassium, lithium, rubidium and cesium, it is concluded that in such solutions the silicate is hydrolytically decomposed into the caustic alkali and colloidial silicic acid. 'On the General Problem of Chemical Statics:' by F. DUHEM. The conclusion of the paper begun in the January number. 'On Integrating Factors:' by P. SAUREL. A mathematical introduction to theoretical studies that are to follow. 'Vapor-tension of Concentrated Hydrochloric Acid Solutions:' by F. R. ALLAN. It is concluded that electrolytic dissociation is not an

adequate explanation of the fact that hydrochloric acid solutions do not obey Henry's law. Book and journal reviews.

March. 'The Equilibria of Stereoisomers:' by WILDER D. BANCROFT. A study of substances having variable melting points. 'Acetaldoxime:' by HECTOR R. CARVETH. A study of its variable melting points. 'Naphthalene and Aqueous Acetone:' by HAMILTON P. CADY. 'Indicators:' by JOHN WADDELL. The effect of organic solvents in discharging the colors of indicators. 'Normal Elements:' by D. MCINTOSH. Book and journal reviews.

Mention should be made of the excellent style and typography of the *Journal.*

THE articles in the current number of *The American Naturalist* commemorate the fiftieth anniversary of the beginning of Agassiz's instruction in Harvard University, marking, as is said in an editorial article, an era in the history of zoology in America. An unsigned article reviews the life of Agassiz, with special reference to his activity as a teacher. Then follow articles on The Philosophical Views of Agassiz, by Professor A. S. Packard; Agassiz and the Ice Age, by Professor G. Frederick Wright; Agassiz on Recent Fishes, by President David Starr Jordan; Agassiz's Work on Fossil Fishes, by Professor Charles R. Eastman; Agassiz's Work on the Embryology of the Turtle, by Mrs. Gertrude C. Davenport, and Agassiz at Penikese, by Professor Burt. G. Wilder.

SOCIETIES AND ACADEMIES.

BOSTON SOCIETY OF NATURAL HISTORY.

AT the general meeting, February 2d, sixty-four persons were present.

Mr. William C. Bates showed a series of lantern views illustrating the natural features of Jamaica and the Jamaicans. He gave a brief historical account of the island and spoke of the advantages due to its accessibility and climate and to many of the interesting characteristics judged from a natural history standpoint. Mr. Bates closed with a series of proverbs and riddles showing that the legends and beliefs of the Jamaicans have many similarities to those of other countries.

A general meeting was held February 16th, with twenty-four persons present.

Mr. John Murdoch read a paper on the animals known to the Eskimos of northwestern Alaska. The climate and natural features of the country near Point Barrow were briefly described, and the behavior of the ice noted. In the capture of animals the bow has been superseded by the rifle. The Eskimos depend upon the walrus, the seals and the whales; the ring seal (*Phoca fœtida*) is the most important animal, the reindeer being next in importance. The polar bears are not common and avoid encounters with men and dogs. The wolf is not found in the vicinity of Point Barrow, but is abundant in the reindeer country; they chase the deer in packs. The tail of the wolverine is especially valued for decorative purposes. The Arctic fox is the most abundant animal found at Point Barrow; it is very shy and so well protected that it is seldom seen. The habits of many birds, the various eiders and gulls, the snow bunting, Lapland longspur, snowy owl and ptarmigan were noted. The Eskimos do not pay much attention to birds.

The Society met March 2d, seventy-one persons present.

Mr. Hollis Webster spoke of some common mushrooms, edible and poisonous, describing in detail the principal characteristics of the common mushroom, *Agaricus campestris*, and of the deadliest member of the group, *Amanita phalloides.* Mr. Webster mentioned the popular interest in the group, its value as food, and noted briefly the classification and method of growth of the fungi. He also described, with the aid of a series of lantern slides, many forms of *Boleti*, *Russula*, *Lepiota*, etc.

At the general meeting held March 16th there were one hundred and fifty-two persons present.

Professor William Libbey read a paper on Cuba, which was illustrated by lantern slides. Professor Libbey's account was based upon personal observation and gave a brief sketch of the country, with special reference to the physical features and to the customs and characteristics of the Cubans.

SAMUEL HENSHAW,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO—FEBRUARY AND MARCH, 1898.

THE PRONEPHROS IN TESTUDINATA.

WIEDERSHEIM, in his paper, 'Über die Entwicklung des Urogenital apparates bei Crocodilen und Schildkröten,' 1890, states that he has been entirely unable to distinguish between pronephros and mesonephros. A study of the earlier development explains his position.

From some very young embryos of Aromochelys and Platypeltis it has been possible to determine the origin and extent of the pronephros. It arises as segmental outgrowths from the posterior somatic region of the somites and is very marked, bridging over the fissure from one somite to the next. The tips overlap and fuse with the following outgrowth. In a very young series the fusion is so complete that a prominent and quite even ridge or welt is formed, extending from the sixth to the tenth somite. Stretching from the end of the pronephros we find the pronephric duct at first close to the somites, further back free, and at its tip at least in some cases fused with the ectoderm. Mitsukuri says he has proved this fusion beyond the possibility of a doubt.

As we proceed to the later stages, however, a new factor comes in which greatly modifies these conditions. Before there is more than a hint of the lumen in the pronephric tubules; we see in some of the same somites (from the second pronephric tubule, on) as well as further back, at the point where they pass in the middle plate, a thickening and occasionally a small bubble-like lumen. These are the Anlagen of the mesonephric tubules. They become more and more distinct. In some series we find the funnel of the pronephric tubule and that of this mesonephric rudiment, opening side by side into the body cavity, but further posterior, and in older embryos we find the pronephric funnels opening into these rudiments of the mesonephros and through them into the body cavity.

There is no break between the pronephros and mesonephros. The first purely mesonephric tubule is in the next somite to the last one which shows the fusion of pronephric and mesonephric elements. Thus it becomes clear that although the pronephros is distinct in origin, it arises as segmental outgrowths from the somites and extends over but few segments; the mesonephros arising from the middle plate extends almost as far anterior as the pronephros, and the two are so fused in the later stages that the parts cannot be distinguished without a study of their development.

The glomus is not seen in any of the stages described, except as a cluster of cells resembling blood corpuscles may be very rarely found alongside of the aorta. Its origin and development will be discussed later with the further development of the excretory system.

E. R. GREGORY.

Titles of other papers read during the two months: 'The Maturation, Fertilization and Early Cleavage of Myzostoma,' Dr. W. M. Wheeler; 'The Germinal Vesicle in Amphibia' (Carnoy), F. L. Charles; 'Dr. Mead on Annelid Cytogeny,' W. L. Treadwell; 'The Stage of Synapsis in the Squid-egg,' Miss M. M. Sturges; 'The Photospheria of Nyctiphanes with Remarks on the Origin of Luminous Organs,' Dr. S. Watase; 'A Comparative Study of Cell Lineage,' S. J. Holmes; 'Notes on a new Peripatus from Mexico,' Dr. W. M. Wheeler; 'A New Pigeon Hybrid,' Dr. C. O. Whitman; 'Carnoy on the Fertilization of Ascaris,' W. H. Packard.

NEW BOOKS.

Fossil Plants. A. C. SEWARD. Cambridge, The University Press. 1898. Vol. I. Pp. xviii + 452. 12s.

A Text-Book of Botany. E. STRASBURGER, F. NOLL, H. SCHENCK, A. F. W. SCHIMPER; translated from the German by H. C. PORTER, PH.D. London and New York, The Macmillan Company. 1898. Pp. ix + 632. $4.50.

Methods for the Analysis of Ores, Pig Iron and Steel. Easton, Pa., Chemical Publishing Co. 1898. Pp. 130. Paper, 75c.; cloth, $1.00.

The Meaning of Education and other Essays and Addresses. NICHOLAS MURRAY BUTLER. New York and London, The Macmillan Co. 1898. Pp xi + 230. $1.00.

Erratum: On page 468, lines 10 and 11 from the bottom of column 1 the words neurite and dendrite should be transferred.

SCIENCE

FRIDAY, APRIL 29, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*A NATURAL HISTORY SURVEY OF MICHIGAN.**

IN Michigan, as in many other States, the desirability, or, perhaps better, the necessity of a survey of the natural resources of the State was early recognized. In 1837 Governor Mason approved an act providing for a geological, zoological, botanical and topographical survey.

It is of interest to note that the early surveys, or explorations, that followed were not limited to a study of the mineral wealth of the Territory. The flora of the regions visited occupied no inconsiderable part of the time and attention of the explorers, and Dr. Houghton's plants in the University herbarium are, many of them, after the lapse of over half a century, still among the finest in the collection. Economical considerations, however, soon led (1840) to the repeal of those portions of the act that pertained to zoology and botany, and but little more was undertaken in this direction until the survey of 1859 and 1860, the report of which, transmitted by Professor Winchell, in 1860, included Geology, Zoology and Botany, the zoological part consisting of an enumeration of birds, reptiles, batrachians and mollusks, while the part devoted to botany includes a list of vascular plants, with remarks on distribution and economical relations.

Since that date the survey has been geo-

*Address by the retiring President of the Michigan Academy of Science, at Ann Arbor, April 1, 1898.

logical. Its scientific and practical value are not questioned, but it is at least an open question whether a return to the more comprehensive plan of the original promoters of the survey is not desirable, and whether there is any reason to suppose that at the present time there are under the earth in Michigan things about which it is more important for us to know than it is to know about those in our waters and in our forests.

The practice of other States may be expected to throw some light on this question. Our neighboring State of Ohio has published, as part of its voluminous report of the Geological Survey, a large volume on the zoology of the State, in which the honored and lamented Chief of the Survey, Dr. J. S. Newberry, takes occasion to speak at some length of the educational and practical value of this part of the work, and Indiana, in its survey by counties, has made large provision for the study of the plant-life of the State, with the object, among other things of preserving, for future generations, a permanent record of the flora as it now exists.

New York State many years ago made appropriations for the natural history side of its survey, and has continued this liberal policy to the present time, and the recent reports of the Geological Survey of New Jersey give large space to the report of the botanist, while Pennsylvania has recently organized a comprehensive survey of its forest resources, and States farther south have set an example which we may well consider. The work of the Alabama Biological Survey comes to us as an example, with the ripe fruits of the long and well-directed activity of that rare scientific genius, Dr. Charles Mohr, and with a corps of younger men eagerly pushing forward into fields that still in Michigan wait our explorations. Can it be that the atmosphere of the Gulf is more invigorating to workers in science than that of the Lakes?

But in some of the newer States of the West we find a still fuller realization of the broad views and more comprehensive plans that, partly in the light of experience and partly as the result of a growing conviction of the inter-dependence of all organic science, have been embodied in the practical workings of the State Surveys. In Minnesota the Survey was organized as late as 1872. It was named—and the name is significant—The Geological and Natural History Survey of Minnesota, and was placed under the direction of the Board of Regents of the University. "The Survey is comprehensive in its scope. The fields of investigation named in the original act are geology, botany, zoology and meteorology."* * * * The results of the investigations already made include so many bulletins, scientific papers and reports that an enumeration would occupy too much time, but they stand as witness to the liberality and breadth of view with which this Survey has been conceived and so far carried out, and we may congratulate the people of our vigorous sister State on "the steadiness of purpose that has held the Geological and Natural History Survey of Minnesota to its work."

It is perhaps unnecessary to go further, although other examples are not wanting of the fact that States characterized by generous and enlightened views have provided, and are now providing, means for Surveys not limited by the bounds of a single science, in which plant and animal life are recognized as being quite as worthy of study as the mineral wealth of the State.

Unfortunately, this is not true of our own State. Former papers before this Academy have not failed to emphasize the patent fact that Michigan, so far from being a leader among the States in organized biological work, conducted by the State, is far behind

*Hall, C. W. The University of Minnesota, an Historical Sketch. Minneapolis, 1896.

others that started later; and the fact that a special committee appointed for the purpose of securing appropriations from the Legislature for printing the publications of the Michigan Academy of Science has thus far met with no success may well lead to careful seeking after the cause of this apparent indifference. Are we producing nothing worthy of the attention of the State? Or is our work good enough in its way, but of no money value, and consequently something that the public money ought not to be spent for? Or is there some occult reason, not yet suggested, for a condition of affairs that, to say the least, is not creditable to the State of Michigan or to the scientific workers within its borders?

I am frank to say that, in my own judgment, we have not always in the past acted with consummate wisdom when we have sought to secure the cooperation of the State in enlarging the scope of the public surveys; but, without attempting to review here a history more instructive than flattering, I may be permitted to express the conviction that in the immediate future, by unitedly and at once taking up certain specific problems that are recognized by every one as being of paramount importance from an economical point of view, the study of which, at the same time, affords full scope for scientific investigation, we shall be taking the surest way to the end in view.

We have in Michigan to-day two such problems presented by our forests and fisheries. It is to the former that I wish for a short time to direct your attention. The facts are familiar, but I am sure that those who have already done so much in this direction are the very ones who will most gladly listen, if by any means we may at length see more clearly and take some actual forward steps toward the working out of the great problem involved in the future of our Michigan forests.

The pine belt of Michigan formed in its day part of one of the finest natural forests on the face of the earth, with its magnificent cork pines hundreds of years old, towering above equally beautiful specimens of sugar maple, basswood, rock elm and other deciduous trees, constituting the beautiful growth of hard wood that still covers so many square miles of northern Michigan. It was a forest that did not grow in a day. It takes about two hundred years for a white pine tree to come to maturity, and many of those cut by Michigan lumbermen were much older, so that when lumbering was commenced in the State one of its great natural resources that had been hundreds of years in making changed rapidly into another form of wealth and disappeared. The later history is familiar to you. Year after year saw gigantic lumbering operations farther and farther extended, and fearful fires sweeping through the *débris*, carrying thousands of acres of virgin forest to its doom, and with it the homes and hopes of settlers, leaving such a picture of desolation as haunts the memory of one who has passed through it, all the more appalling because of the tragic wreck of human interests, and the apparently hopeless outlook for the future.

It is well for us servants of the State, even if devotees of pure science, to try and form some conception of the magnitude of an interest that has been so conspicuous an element in the material development of the Commonwealth. Briefly, then, as early as 1881 the aggregate value of the forest products of the State was estimated to have reached more than a billion dollars, and, now after half a century of lumbering, and after the closing of one great mill after another and removal of the operators to other fields, the State of Michigan alone produced in 1897 2,335,000,000 feet of lumber and 1,284,000,000 shingles. These figures may produce no real conception of what they stand for, but they may help us

in some measure to appreciate the fact that the prosperity of the State has been due very largely, if not chiefly, to its forests, and that the State must inevitably suffer a loss not easily estimated through the certain diminution of this great source of wealth.

We may now raise the question whether all this is any concern of the State, whether as a Commonwealth it is under any obligation to seriously take up the question of forest reserves and State control, and, if so, what can be done? And, in the second place, we may inquire whether individual citizens, and especially those who have had scientific training, have a duty in the premises.

There is a school of sociologists who hold that the functions of government should be reduced rather than extended; that they govern best who govern least; and that "the good of the nation is attained by inactivity rather than by active exertion of the government, by allowing the individual to work out his own salvation (or damnation) amid the free and unrestricted play of natural forces, rather than making them do so." Such *laissez-faire* doctrines, however, will hardly appeal to that more enlightened and healthy public sentiment that regards the function of government as legitimately exercised "wherever cooperation of the whole will accomplish the end aimed at by society better than individual effort." *

Now, as pointed out by Dr. Fernow, from whom I have already quoted, government has what may be called providential functions in regard to natural resources. It is the "representative not only for communal interests as against individual interests, but also of future interests as against those of the present. * * * Its activity must be with regard to continuity, must provide for the future, must be providential," and this in the case of such a natural resource as the one under consideration is possible only under the supervision of permanent institutions, with which present profit is not the only motive.

These principles embodied in the scientific forestry of the Old World have resulted in the establishment of a well-nigh perfect system under which in France the sandy wastes of Gascony have been covered with productive forests, and denuded mountain slopes, the play of destructive torrents, have been clothed again with their protective covering of sod and trees; while in the German Empire a clear annual revenue of $40,000,000 shows something of what is practicable under State control of forest property.

In the New World, in recent years, one State after another has come to recognize the necessity as well as the reasonableness of government care of the forests, and in several States important Legislative enactments have defined the policy and rights of the Commonwealth in this direction.

In the State of New York a law enacted April 25, 1895, provides for a Commission of Fisheries, Game and Forests, with power to appoint thirty-five foresters, whose duty it is to enforce all laws and regulations of the Commission for the protection of fish and game and for the protection and preservation of the forest reserve and all rules and regulations for the care of the Adirondack Park. The law provides further for the care and superintendance of the forest preserve, for protection against fire, actions for trespasses, and for the purchase and taxation of lands belonging to the State.

The New York State Legislature last year appropriated $1,000,000 for the purchase of land in the Adirondack region, and the State now owns 800,000 acres (out of the 2,500,000 acres) of forest land in that section. This year $500,000 will be placed in the hands of the Forest Preserve Board to continue the purchase of forest lands,

* Fernow, B. E., SCIENCE, Vol. II., p. 258.

and part of this sum, it is expected, will be expended in the purchase of 25,000 acres that will be given in trust to the authorities of Cornell University for twenty-five years, with the aim of having an experiment in forest preservation and culture tried.*

It is thus with well-matured plans, looking far into the future, that the State of New York has made liberal and far-sighted provision for its forest interests, finally calling to the aid of the State the services of the University and giving a quarter of a century in which to conduct an experiment that can hardly fail to be productive of important results.

The Legislature of Pennsylvania, at different times within the past few years, has passed laws establishing and prescribing the duties of a Forest Commission to report upon the condition of the slopes and summits of the important watersheds of the State, the amount of standing timber, the part or parts of the State where each grows naturally, and to suggest measures for maintaining a proper timber supply. Provision is further made for the enforcement of laws designed to protect forests from fire and for the preservation and increase of the timber lands of the State and for securing forest reservations adjacent to waters draining into the Delaware, Susquehanna and Ohio rivers.

Most instructive, perhaps, on account of similarity of conditions, is the recent history of forest legislation in Wisconsin. The Legislature of 1897 passed a law authorizing the Governor to appoint a commission consisting of three members to devise and draw up a plan for the organization of a State forestry department. The plan is to include provisions for the reservation by the State of all lands which are better fitted for the growing of timber than for agricultural purposes, the purchase of similar lands abandoned by their owners, and the management and replanting of forests according to the principles of scientific forestry. They are also to draw up a plan by which the forestry department may be from the first self-supporting and in time become a source of revenue to the State.

It was provided that the commission should receive no compensation, but the services of a competent expert connected with the Forestry Division at Washington were secured, and $500 toward his actual expenses were provided by the State Geological and Natural History Survey. Mr. Filibert Roth, who was detailed for this work, entered upon his task with characteristic energy, and in a month's journey visited 27 counties with a total area of 18.5 million acres. His report* is of special interest, giving, as it does, a remarkably clear statement of the condition of things over an area embracing fully half of the State of Wisconsin, including 8.5 million acres of cut-over land, most of which is burned over and largely waste, and on which some twenty billion feet of pine has been destroyed by fire. The value of the timber product of former years is suggested by the statement that "the forest industries have built every foot of railway and wagon road, nearly every town, school and church, and cleared half of the improved land in northern Wisconsin."

The discussion of the future of this great area, once a natural forest, now largely a wilderness, necessarily involves great uncertainty. Trees cannot be made to grow by an act of legislation, and the Legislature itself is an uncertain factor. Mr. Roth proceeds to show that in Wisconsin "the hardwoods, though perfectly able under normal conditions to hold their own and continue as forests, have not done so," and "that hemlock has failed to reproduce itself for a long time," while the white pine, is, per-

* New York *Tribune*, February 19, 1898.

* Preliminary Report on Forest Conditions in Northern Wisconsin. Washington, 1898.

fectly capable not only to continue as a forest, but also to re-clothe old burned-over slashings on all kinds of soil. But it is equally certain that the great mass of pine slashings have remained and will continue to remain barren wastes, and that of the 8,000,000 acres of cut-over lands in north Wisconsin not one-tenth is stocked with growing timber. And the swamp woods have no future, for it is here among the tall marsh grass and masses of dead poles that most of the fires start.

"In this way an area now nearing 8,000,000 acres, and rapidly increasing in extent, remains unproductive. Counting only 20 cubic feet, or 100 feet B. M., as the annual growth per acre on lands entirely without any care or protection against fire, the State of Wisconsin loses annually by this condition of things 800,000,000 feet B. M. of marketable saw timber; nor is this all, for even with primitive management this amount could be largely increased.

"The assertion that this land is needed for agriculture, that it soon will all be settled, and that even the sandy soils produce potatoes and are profitably farmed by improved methods, may well be answered by a concrete case. The old settled counties Waushara, Adams, and Marquette have an aggregate area of 1,144,000 acres; their improved land amounts to 340,000 acres, leaving fully 70 per cent., or 804,000 acres, in brush and waste lands. In 1895 these counties supported wood industries whose products amounted to the pitiful sum of $13,000, and probably the material for these was imported, instead of having 80,000,000 feet of pine to sell, which under simple methods of care might have been derived from these brush and waste lands."

It will be seen that in this preliminary survey and report an important and valuable contribution has been made, which has opened the problem for further investigation, demonstrating meanwhile the extent of the interests that are involved in its practical study. The Forestry Commission of Wisconsin fully realizes this, and is actively at work with plans for the future.

The similarity of conditions in the two States and the solid progress already made in Wisconsin suggest that we can probably do no better at present than to adopt substantially the same measures, namely, to obtain through the State Legislature enough to pay for the services of an expert for, say, six months—long enough to give sufficient data to go to work on—and meanwhile secure also, through the Legislature, the appointment of an unpaid State Forestry Commission to formulate plans for the future. Such a course as this can not possibly be open to the charge of political jobbery; the initial expense to the State is so little as to be hardly worth mentioning, and the end to be obtained is of such far-reaching importance as to warrant, or rather imperatively demand, the earnest work and personal sacrifice that will be involved in this patriotic effort to restore in some measure the forest wealth of Michigan and to make forever impossible the frightful waste of natural resources that has been so conspicuous a factor of our recent history.

It will naturally be asked: Is this all that the Michigan Academy of Science is to do in formulating plans for a Natural History Survey of the State? Workers, many of us, in pure science, are we to rest satisfied with merely formulating a plan by means of which the material interests of the State are to be subserved? Ought we not rather to develop a comprehensive plan by means of which biological relations of every kind shall be brought under scientific investigation? Shall we not leave practical matters to practical men and give ourselves to that to which we were called—our laboratories, our students, and the pursuit of science for its own sake?

Such questions lead finally, as it seems to

me, to the answer that the interest of one is in the end the interest of all. Scientific investigation, in Michigan at least, is to a great extent dependent on means provided by the people of the State, who are paying, generally with cheerfulness, sometimes with more or less questioning, for the equipment of the laboratories in which we work. Such is our dependence, let us frankly acknowledge it, and hold ourselves ready to make such return as we are able. On the other hand, the people of the State are dependent—more so, perhaps, than is sometimes admitted—on trained scientific men for the working-out of nearly every problem affecting their material interests. There is not a practical man in Michigan competent alone to successfully work out the problem as to just what the State ought to do in the preservation and profitable management of its forests. Here the services of trained scientific experts are indispensable, and fortunately this University was, eight or ten years ago, engaged in training the man who is now fitted to render this service and stands ready to do so.

In the second place, a full recognition of material obligation and the taking-up of just such practical problems as this will not hinder, but will pave the way for, the more extended investigation of the natural history of our State that we all hope to see accomplished. It is, I am convinced, the part of wisdom to begin our Natural History Survey of Michigan with this great and pressing problem; but no one could think for a moment that it should end there. Here, as elsewhere, means are certain to be forthcoming as it becomes evident that they are deserved, and I believe that we may today begin to plan for just such a comprehensive biological survey of the State as would satisfy the most extended and exacting scientific requirements, assured that in due time we shall have full means for its accomplishment.

I should hardly think of attempting offhand to draw up a requisition or to unfold a comprehensive plan for such a survey. But there are certain principles, or facts, that through their inherent reasonableness must, I think, command general assent and upon which we may proceed until we can see further.

First, there ought to be within the State a collection of books of such extent that the literature of any branch of natural history may be within the reach of specialists, without the necessity of borrowing or undertaking long and expensive journeys. Such collections of books are a necessity and the development of scientific work in Michigan will be advanced or hindered according as they are or are not provided. We can not have these books in a day; but we can and ought to make their necessity known, and to use every legitimate means to secure them. The State of Minnesota, in connection with its Natural History Survey, appropriates year after year what would seem to us a munificent sum for the purchase of books that go into the University library and there become permanently available for purposes of research.

Secondly, there ought to be provision for the publication, by the State, of all material that has assumed sufficiently complete shape to be an actual contribution to our knowledge of the various plants and animals within our borders. Not a little valuable material, to the knowledge of the writer, lies packed away in the laboratories of the State that should be published as a part of its Natural History Survey, that with the assurance of publication in creditable form would be steadily growing, instead of remaining at a stand-still. It is, I think, the duty of our Academy to press this upon the attention of the State government until the want is supplied.

In the third place, passing now to matters that may be determined largely by in-

dividual agreement rather than by State action, we may profitably aim both at greater specialization and more intelligent cooperation. When one has made himself a thorough student in any special field it would seem both courteous and expedient for all of us to recognize that field as his, to send him material that falls into our hands, and to cooperate with him in every way in our power. I do not mean, of course, that a summer or two of amateur work constitutes a claim to preëmpt any special group or subject, nor, on the other hand, that any one should be precluded from doing his utmost in any field whatever to which his choice may lead him, but that we ought to recognize the necessity of a division of labor, and also the fitness of looking to those who for a score of years or a lifetime have carefully worked some restricted field as the natural depository of material, and authorities to whom we may go for help and to whom we may gladly render service in their further studies.

Lastly, the question of organization—by no means an easy one—is best approached by an attentive study of the recent experience of other Commonwealths. If we were starting without traditions, with the virgin soil of a new territory open to us, it would, perhaps, be hardly possible to devise an organization with a more comprehensive, practical and reasonable working basis than that of the State of Minnesota. But we are not starting that way. Our State Survey has its traditions. We have several centers of scientific work instead of one and it is inevitable and desirable that, directly or indirectly, they should have a hand in much at least of the scientific work that in the future is undertaken by the State.

This condition of affairs would perhaps suggest a form of organization similar to that of Indiana, in which a Biological Survey was inaugurated by the Academy oi Science five years ago. This has since been adopted by the State, and is quite distinct from the Geological Survey, though working in entire harmony with it, the State Geologist being an active member of the Academy. "In a very short time," says Professor Stanley Coulter, "the work in this Survey was felt to be of great importance to the State. An application to the Legislature secured an annual appropriation of $600 for the publication of the proceedings. The Academy furnishes the material and the editorial supervision without cost to the State. The State, however, prints and provides for the distribution of not less than 1,500 copies annually of the proceedings." We have then, at our door, a successful solution of the question by a State in which the situation of affairs at the inauguration of the Biological Survey was nearly identical with that in the State of Michigan at the present time. We can hardly do better than to learn of our neighbor and move forward.

To recapitulate: It has been the purpose of this paper to formulate and emphasize the following facts:

1. The responsibility of the State for a scientific study of its own natural resources has become fully established by the continuous practice of our own and many other States.

2. Equally well established in theory, and in various States in practice also, is the fact that a Biological or Natural History Survey is of as great importance and has as great claims upon the State as a Geological Survey.

3. The time is favorable in Michigan for for undertaking a Natural History Survey; and the State Academy is the natural source from which the movement should originate.

4. The Survey should be projected on a broad, liberal and comprehensive plan, but it should include at the outset a specific problem of practical importance and at the same time of scientific interest.

5. Such a problem is presented in the future of the waste lands once covered by the pine forests of Michigan. It is certain before long to attract enough public attention to become a subject of legislation, and our present attitude may do much to determine the course of events in this direction.

6. Meantime there is every reason in favor of proceeding as rapidly as practicable, along lines already suggested, in the development of our State Biological Survey. This, in fact, if not in form, has long been in progress, as the studies of 'Unionidæ in Michigan,' the 'Birds of Michigan,' the 'Michigan Flora' and various other pieces of work of high scientific merit abundantly testify. But it is time now that the work should be organized, that the State should recognize its duty to this form of scientific work, and that we ourselves should be forming clear conceptions of the ecological problems that, in wonderful, if perplexing, interest, are sure to attend, into the twentieth century, the Natural History Survey of Michigan.

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A COMPLETE SKELETON OF CORYPHODON RADIANS—NOTES UPON THE LOCOMOTION OF THIS ANIMAL.

THE chief object of the American Museum Expedition of 1896 was to complete materials for the investigation of the evolution of the Amblypoda, and extend our knowledge of *Coryphodon*. Previous observations have been principally upon scattered and imperfect material, and it seemed of the utmost importance to secure materials sufficient to determine the relations of this animal to its ancestral form *Pantolambda*, and to its successive form, *Uintatherium;* also the proportions of the body, the positions of its limbs and the number of its vertebræ. Accordingly the Museum party, led by Dr. Wortman, spent the months of April and May in northwestern New Mexico, revisiting the locality where Cope's most complete *Coryphodon*, *C. elephantopus*, had been found. The search here in the 'Coryphodon' or 'Wasatch Beds' was entirely unsuccessful, but fortunately the underlying 'Torrejon Beds' yielded a remarkably complete series of *Pantolambda*. The party moved to the north in June, and devoted July and August to a most energetic exploration of the Big Horn Basin, especially of the exposures on the south side of the Gray Bull River from Brown's Ranch towards the Big Horn River below Otto.

As a result, parts of 18 individuals were found in the Wasatch Beds (supplementing the 30 individuals found in 1891), and 7 individuals in the Wind River Beds. The selection of portions of nine individuals for mounting was done with great care as follows: The mounted skull, 'American Museum Catalogue,' No 2,867, agrees exactly in size, and is specifically identical with the skull and jaws of No. 5,829. The latter (No. 2,829), while laterally crushed, had associated with it the right scapula and complete forelimb, left scapula and parts of left limb which were used in mounting; also all the vertebræ as far back as the pelvis; these vertebræ, while too much crushed to mount, enabled us to determine the formula and select, from series Nos. 2,865 and 2,863, vertebræ which exhibit the same characters. The latter individual (No. 2,863) included the pelvis and hind limb, thus determining *positively the correct proportions of the entire animal.* The mounting was done with great skill and care by Mr. Hermann.

In general one is struck by the very large size of the head, formidable front teeth, the shortness of the ribs, the heavy character of the girdles, the heavy limbs, and the semiplantigrade or subdigitigrade condition of the feet. It is probable, as already shown

by the writer, that in the hind foot the calcaneum nearly reached the ground in the forward step.

	FEET AND INCHES.	METERS.
Length, incisors to perpendicular of tail	7′ 9½″	2.38
Height at withers.........	3′ 4½″	1.03
Fore limb............	2′ 8½″	.82
Hind limb...............	2′ 11½″	.90

The *skull* presents a very peculiar appearance with its powerful and spreading upper and lower canines, and widely spaced incisors, slender zygomatic arch and broad, flattened cranium.

The rudimentary horn observed for the first time in the parietals is prophetic of the great parietal horn of *Uintatherium*. Many other characters of the skull and skeleton are also prophetic, but there is little tendency displayed to reduce the upper incisors or lower canines into the Uintathere type.*

GENERAL APPEARANCE OF CORYPHODON.

The most accurate forecast of the appearance of the animal was that made by Cope† in 1874:

"The general appearance of the Coryphodons, as determined by the skeleton, probably resembled the Bears more than any living animals, with the important exception that in their feet they were much like the Elephant. To the general proportions of the Bears must be added a tail of medium length. Whether they were covered with hair or not is, of course, uncertain; of their nearest living allies, the

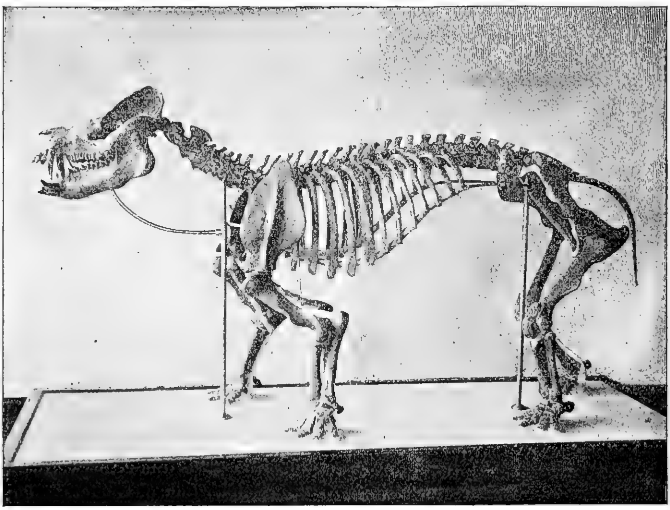

FIG 1.—Mounted Skeleton of *Coryphodon radians*. Slightly exceeding one-fifteenth natural size.

* *Bulletin American Museum of Natural History*, April 4, 1898.

†Vertebrate Paleontology, Vol. IV., Wheeler Survey, p. 203.

Elephants, some were hairy and others naked. The top of the head was doubtless naked posteriorly, and in old animals may have been only covered by a thin epidermis, as in the Crocodiles, thus presenting a rough, impenetrable front to antagonists.

"The movements of the *Coryphodons*, doubtless, resembled those of the Elephant in its shuffling and ambling gait, and may have been even more awkward, from the inflexibility of the ankle. But, in compensation for the probable lack of speed, these animals were most formidably armed with tusks. These weapons, particularly those of the upper jaw, are more robust than those of the Carnivora, and generally more elongate, and attrition preserved rather than diminished their acuteness. The size of the species varied from that of a Tapir to that of an Ox."

Osborn* in 1892 wrote as follows:

"The fact is, the position of the fore and hind feet of *Coryphodon* is absolutely different. The *fore foot was digitigrade*, like that of the Elephant; the *hind foot was plantigrade*, like that of the Bear. In other words, the carpus was entirely raised from the ground and the manus rested upon the distal ends of the metacarpals and upon the spreading phalanges, while the calcaneum and tarsus rested directly on the ground, together with the entire plantar surface of the foot. This substantial difference between the advanced state of evolution of the fore foot and retarded evolution of the hind foot is of great interest. It is clearly shown in the accompanying figures."

In 1893 Marsh,† in his description and restoration, presented quite a different conception of the animal as *unguligrade*. In regard to these matters he made the following statement: "The position first given to the figure is retained in the restoration after a careful investigation of the whole posterior limbs in a number of well-preserved specimens. In *Dinoceras* the terminal phalanges are much larger than in the Elephant, so that they thus bore a greater weight, the digits being undoubtedly free, although a pad may have helped to support the feet. In *Coryphodon* the digits were still more elongate and the terminal phalanges proportionately larger and broader, indicating that they were covered with hoofs that supported the feet. This would agree with the position given them in the restoration, which coincides with the anatomical structure of the entire hind limb."

It appears from our more complete material that the difference between the feet was exaggerated by Osborn, as already observed by Marsh. There is no doubt, however, that, as seen in the mounted specimen, in the forward step the calcaneum rested very near the ground, being separated merely by a thick plantar pad. The digits of the fore and hind feet have nearly the same relations to the ground. *Both feet are in a somewhat similar stage of transition between plantigradism and digitigradism. Pantolambda* has a long tuber-calcis and pes like that of the Bear. *Uintatherium* has a very short tuber-calcis and bore the pes slightly more plantigrade than the elephant. *Coryphodon* has a tuber-calcis intermediate in length; in the astragalus the upper facet for the tibia and lower facet for the navicular presents an oblique angle, the astragalus thinning out to a sharp edge in front (whereas in *Uintatherium* these facets are more nearly parallel, and the astragalus is truncate in front). The angles between the tibial and navicular facets of the astragalus, as shown in sections in Fig. 2, afford the most de-

*Fossil Mammals, of the Wasatch and Wind River Beds, Collection of 1891; Osborn & Wortman, Bull. Am. Mus. Nat. Hist., Sept., 1892, p. 121.

† 'Restoration of Coryphodon,' *Amer. Jour. Science*, Oct., 1893, p, 324.

cisive evidence that the pes of *Coryphodon* was intermediate between the nearly plantigrade *Pantolambda* and the sub-digitigrade *Uintatherium.*

In general *Coryphodon* had a very short back and short, spreading limbs, with a very clumsy, shuffling gait.

HENRY F. OSBORN.

THE MYTH OF THE OZARK ISLE.

THE Ozark uplift, which occupies nearly all of south Missouri and northwestern Arkansas, has long been known as the only noteworthy elevation existing in the whole continental interior plain. Geologically all of this vast region, stretching out from the Appalachians to the Rockies and from the Great Lakes to the Gulf, is made up largely of late Paleozoic or younger rocks, save in one spot, the Ozarks.

As a geographical feature the Ozark uplift is a great, broad dome. Its general surface still preserves the outlines of the great peneplain that existed in the region before the country was affected by mountain-making forces and bowed up. The margins of the elevation are marked approximately by the Missouri river on the north, the Mississippi on the east, the Neosho on the west and the Red river.

The geological structure of the uplift is relatively simple. In the highest or central part are the oldest rocks exposed in the entire Mississippi basin. These are the Algonkian granites and porphyries, the commonly called Archæan nucleus. Surrounding these massive crystallines and occupying nearly all of the central portions of the dome are the Cambrian and Silurian dolomites, the so-called great magnesian limestone series. Farther outward lie successively the Devonian, Lower Carboniferous and Coal Measures. The latter also form the principal surface rocks of the surrounding plain, beyond the margins of the uplift. Thus the great dome presents the oldest rocks in the central and highest parts, and towards the margins and foot younger and younger belts in concentric rings.

This striking and peculiar arrangement of the geological formations around the Ozark dome has long attracted notice, and it has always set forth as one of the direct proofs that the uplift is very old and that the region has remained practically unchanged above sea-level since pre-Cambrian times, forming in the midst of the broad and shallow continental sea a large, ever growing island around which sediments were constantly laid down during all the Paleozoic period. Starting with these premises there have been based recently a number of broad generalizations and rather fantastic hypotheses regarding the deposition and origin of various ores found in the region, the courses of Paleozoic ocean currents, the formation of unusually thick sediments of certain geological age, the distribution of some ancient and peculiar faunas, and even the isolated and independent development of life in the region. These various hypotheses are very attractive in themselves. Based wholly on the assumption of the existence of a large land area in the middle of the continental sea, the colateral evidence used in several of the arguments are strangely corroborative. But going back of the original proposition that has been taken for granted and that has served as the foundation for the several hypotheses advanced, a question naturally arises as to the real grounds for the premises and for the assumed great antiquity of the 'Ozark Isle.'

If there is one thing that modern geography teaches before all else in regard to the existence of an elevated land area, such as is claimed for the Ozark region during all the long span from the pre-Cambrian to the present, it is that it would have been long since worn down to a low-lying plain of faint relief, indistinguishable from the vast

plain around it. But there is a more direct method of finding out whether or not the Ozark uplift really does possess the great age ascribed to it. Marbut, Davis, Griswald and others, who have recently given the region special study from both the geographic and geologic standpoints, all agree in regarding the uplift, as it now stands, as a very modern feature of relief—that is, they assign the age as not earlier than middle or late Tertiary. The proofs that these authors bring forth seem indisputable. Furthermore, there is ample evidence for believing that there were two periods of uprising—one in which the region was bowed up and then reduced to a peneplain, and the other in which the peneplained surface was again uplifted to near its present position. The remnants of the once level plain are still plainly discernible in the existing general surface.

There is another wholly different line of evidence, going to show that during all Paleozoic time no island existed in the present Ozark region, and that the formations later than Cambrian were not laid down in concentric zones around the central crystallines. It is believed that there is ample proof that all Paleozoic formations now represented around the foot of the uplift extended in unbroken sheets over the entire area now elevated, and were not removed until Cretaceous or Tertiary time. Part of the evidence has been published for many years, though it appears to have escaped notice, but much new information bearing directly on this point has been obtained lately. It is essentially this: Far up on the back of the dome—more than three-fourths of the distance from the foot, where the main bodies of the several formations exist, to the central part of the elevation—there are still preserved outliers of Devonian, Lower Carboniferous and Coal Measures. Some of those of the age first mentioned occur very near the summit of the great dome, while those last referred to extend to within 300 feet of the crest. Abundant fossils leave no doubt as to the proper reference to the age of these isolated deposits lying on the older magnesian limestones which constitute the main mass of the dome.

Without going fully into details it must be conceded that the widespread idea of the existence, during Paleozoic times, of a wondrous Ozark Isle, in the midst of a vast continental sea, is a trifle mythical, and it, therefore, must be relegated to the realm of the fanciful.

CHARLES R. KEYES.

NEW YORK STATE SCIENCE TEACHERS' ASSOCIATION—SECOND ANNUAL MEETING, ITHACA, DECEMBER 30–31, 1897.

THE growth of this Association during the past two years has been most encouraging to all friends of science in the State. The Ithaca meeting was marked by a deep interest in the objects of the Association; this was manifest not only in the large attendance, especially of college and normal school professors, but in the earnest discussions at each session, particularly after the Report of the Committee of Nine. The meetings of the American Society of Naturalists and their affiliated societies on Tuesday and Wednesday, and the presence of a number of their members at the meetings of the Teachers' Association, created an atmosphere especially favorable to the objects of the convention. If, perchance, anything could have been lacking to make the environment perfectly auspicious it was supplied by the words and spirit of President Schurman's welcome. He showed himself warmly interested in raising science teaching to the highest efficiency and was ready to recognize thorough preparation in science as a requirement for entrance to college. Throughout all the sessions there was abundant evidence that in accepting

the hospitality of Cornell University the Teachers' Association had found for itself a host of friends. Invitations to go this year to Syracuse and Utica were set aside, and the Council voted to meet with Columbia University and the Teachers College in 1898, following, again, the American Naturalists.

At the first session, Thursday afternoon, Miss Mary E. Dann, of the Girls' High School in Brooklyn, read a paper on 'Physical Laboratory Work in Secondary Schools.' It was evident from this paper and the discussion following it that the sentiment of the Association is unanimous in favor of laboratory work by the pupil in physics, the chief questions being how much? and how? No one questioned the desirability of making some sort of a beginning in schools where such laboratories do not exist.

Dr. E. L. Nichols, the President, lectured in the evening on 'The use of the Lantern in Science Teaching.' He demonstrated the comparative virtues of kerosene, the lime light and electricity, by throwing these three lights side by side on the same screen from three separate lanterns. A number of demonstrations in physics were then projected by the electric lantern.

The evening reception by Dr. Nichols and Mrs. Nichols was a very delightful feature of the meetings.

On Friday morning Professor Cooley, Chairman of the Committee of Nine, read the preliminary report prepared for this meeting. The full text may be obtained from members of the committee. It is printed in the April number of the *Journal of Pedagogy*, Syracuse, together with the papers by Miss Dann and Professor Underwood. The report concludes with three significant theses, which may be summed up as follows:

1. An immediate effort should be made to formulate the objects, lay out plans and surmount the difficulties in the way of a continuous course of nature study in elementary schools. 2. The sciences should be taught in secondary schools by a combination of oral instruction, text-book study and laboratory work; laboratory work should be definitely provided for in the planning of courses, programs and examinations. 3. Science should be accepted as preparation for college when the science has been pursued five hours per week for a year by the method outlined above; when the original records of laboratory work are submitted for inspection by the college, and when all tests of the quality of the work are not less severe than those applied in mathematics and Latin.

These conclusions were well sustained by the speakers of the morning. Lack of suitable preparation on the part of science teachers in the secondary schools was frequently referred to, and it was urged by several speakers that the Association should do something definite in the way of assisting such unprepared teachers in making the right beginning in their science work. This matter and several other propositions dealing with more thorough science work in secondary schools, and the recognition of this work as a requisite for entering college, were referred to the Committee of Nine, to be acted upon before the next annual meeting.

'The Study of Botany in High Schools' was the subject of Professor L. M. Underwood's paper, and of the well sustained discussion following it. Here, again, the importance of trained teachers who can teach lessons from plants as well as from books was repeatedly emphasized, and various means of self improvement were suggested, such as summer schools and special courses in our colleges and universities.

The claims of the American Association for the Advancement of Science were presented by Mr. William Orr, Jr., of the

Springfield, Mass., High School. He urged the science teachers in secondary schools to interest themselves in this national organization, and extended an especial invitation to attend the anniversary meeting next August.

The closing session, Friday afternoon, began with three round tables. The representatives of union schools and academies were led by Principal Thomas B. Lovell, of the Niagara Falls High School, Normal School teachers by Professor Howard Lyon, of Oneonta, and College teachers by Professor B. G. Wilder.

Principal Frederick A. Vogt, of the Central High School in Buffalo, introduced the topic of 'Out-door Science Work in Secondary Schools.' He outlined a number of ways in which the 'laboratory method' may be most profitably employed in the open air, and he contended that many schools, especially in rural districts, are neglecting this most fruitful and convenient means of education and leaning too much on the traditional grind of the school book. The discussion showed that out-door study wherever it has grown to be a feature of science courses is becoming more systematic and rational than formerly. The demand for better work in this line is met by special courses in summer schools and by the preparation of leaflets and guides such as have been issued by the College of Agriculture of Cornell University and many similar institutions.

The following are the officers for 1898:

President, Charles W. Hargitt, Syracuse University.

Vice-President, John F. Woodhull, Teachers College, New York.

Secretary and Treasurer, Franklin W. Barrows, 45 Park Street, Buffalo, of Central High School.

Executive Council:

Professor William Hallock, Columbia University, New York.

Miss Mary E. Dann, Girls' High School, Brooklyn.

Professor D. L. Bardwell, State Normal School, Cortland.

Dr. Charles W. Dodge, University of Rochester.

Principal Thomas B. Lovell, High School, Niagara Falls.

Professor W. C. Peckham, Adelphi College, Brooklyn.

Professor J. McKeen Cattell, Columbia University, New York.

Professor Le Roy C. Cooley, Vassar College, Poughkeepsie.

Professor E. R. Whitney, High School, Binghamton.

Professor Irving P. Bishop, State Normal School, Buffalo.

Mr. Charles N. Cobb, Regents' Office, Albany.

Professor C. S. Prosser, Union University, Schenectady.

A more detailed report of the meeting is published in *The School Journal*, New York, for March 19th and 26th. Dr. Nichols' lecture and Principal Vogt's paper are published in later numbers of the same periodical.

Franklin W. Barrows,
Secretary.

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*THE NATURAL HISTORY MUSEUM, LONDON.**

Those who have visited the Natural History Museum recently and have marked the admirable manner in which the specimens are classified, labelled and arranged in the gallery of mammalia will readily appreciate how valuable an addition to the resources of the student the improvments in the mode of exhibition and the methods of mounting specimens now in progress in the other zoological galleries will afford when the work is complete. As regards the mammals the rearrangement is in a fairly finished state, though of course the process of elimi-

* From the London *Times*.

nating badly-stuffed or worn-out specimens and replacing them as opportunities arise by the best examples of modern taxidermy is one which must ever continue if the Museum is to be maintained as an institution worthy of the nation. As an instance of the difference between the old style and the new, attention may be directed to the fine specimen of a wild lion, shot by Mr. S. L. Hinde, an officer in the service of the British East Africa Protectorate, near Machakos, on August 28, 1897, which is now splendidly set up in a prominent position among the carnivora, having lately taken the place of the old male menagerie specimen, grotesque-looking at the best, presented years ago to the Museum by the well-known showman Van Amburgh.

A feature of the extensive changes at present being made is the gradual disappearance of the polished sycamore stands which for very many years have been in use throughout the zoological department. The light color and reflecting surfaces of these stands not only obtrude themselves on the attention of the visitor, but they do not at all harmonize with the general tone of the specimens. The difficulty has been to find a good substitute. After many experiments of different colors and kinds of surface it has been finally resolved to adopt a suggestion made to Sir William Flower by the late Lord Leighton to use for the majority of the stands a dull surface of a good cigar-brown, produced by staining the wood.

Evidence of reform and reorganization is to be seen in the bird gallery, and here it may be noted that the formal turned perches on which the birds were mounted, and which necessitated a perfect uniformity of position, are being replaced by pieces of natural branches, allowing the taxidermist far greater freedom and variety in mounting the specimens. The new order or classification of the class *Aves* commences on the north side of the gallery, with the struthious birds, or ostrich tribe, including the emus and cossowaries of Australia, the rheas of South America, and the living apteryx and, but recently extinct dinornis, or moa, of New Zealand, and then will proceed through the tinamous, game birds, pigeons, rails, plovers, gulls, petrels, and ducks to the large saloon at the western end of the gallery, where the pelicans and cormorants and some of the birds of prey will be exhibited. On the south side of the gallery will be arranged the remainder of the birds of prey, the owls, parrots, and other picarian birds as well as the perching birds, with which the arrangement will conclude on the left of the main entrance to the gallery. A student, therefore, wishing to examine the higher forms of bird life can, when the work is finished, begin on the left or south side of the room and pursue his studies in regular sequence until he arrives at the ostriches and other flightless birds, or he may commence with the latter and end with the highest forms of passeriformes or perching birds. So far the rearrangement has been completed to the game birds, and many splendid examples of pheasant, partridges and grouse are to be seen. An addition made within the last few days is the group of peafowl, perhaps the most striking and beautiful case in the gallery. It includes examples of the common peafowl, one of the males with the train expanded, a pair of the Burmese peafowl, a hybrid between these species bred in the zoological gardens, and an example of the black-shouldered peacock—a very handsome variety of the common species which has not been met with in a wild state. Among the pigeons which have just been provisionally placed in their case may be seen a fine pair of the now nearly extinct passenger pigeon (*Ectopistes migratorius*). These are remounted examples which have already done nearly fifty years' service, but look as fresh as if they had been shot yesterday.

In the gallery of reptilia an important and valuable acquisition has recently been made in the shape of an unusually large specimen and a skeleton of the Gangetic crocodile or gavial of the Ganges, measuring 16 feet in length. It is thought that no other skeleton of this species is to be seen in any museum or collection in Europe. This powerful and truly formidable looking animal feeds chiefly on fishes, for the capture of which its long and slender snout and sharp teeth are well adapted, but it occasionally devours human bodies.

One of the most beautiful sections of the Museum is the coral gallery, where many decided improvements are noticeable. Thus the sea-anemones in spirit, which do not look very much like sea-anemones in the sea, have had cleverly-executed water-color drawings of living specimens put beside them. The new whale room, for the exhibition of life-sized models and skeletons of whales on a scale never before approached, is making good progress under the director's constant supervision, and will probably be ready for the admission of the public early in the summer.

In the department of geology the recent accessions are many and varied. One which is of special importance and interest is the complete skeleton of *æpyornis*, an extinct wingless bird as large as an ostrich, 5 feet 2 inches in height. The specimen has been reconstructed from the immense series of remains collected in the neighborhood of Sirabé by Dr. C. I. Forsyth Major during his recent expedition to Madagascar. Close to it has been placed for comparison a skeleton of the recent African ostrich.

An interesting specimen presented by Dr. John Murray, of the Challenger, has lately been added to the collection of rocks in the mineral gallery. It is a fragment of gneiss or rock dredged up by the Challenger from diatom ooze at a depth of 1,950 fathoms in the Antarctic Ocean, latitude 53° 55′ S., longitude 108° 35′ E., and is stated to be indicative of Continental land, it having been probably transported by the Antarctic icebergs from land situated towards the South Pole.

Recent additions to the botanical gallery include a table case illustrating parasitic flowering plants. The visitor will note not only the familiar mistletoe, but the more degenerate forms closely resembling fungi in their outward appearance. On the opposite side of the gallery a similar case is nearing completion in which the singular adaptations of flowers to fertilization are exhibited. The models of flowers by Miss Emett are among the most successful this lady has ever made. The exhibition of British fungi is also now nearly complete and the arrival of a new pedestal case is all that is needed to set forth the continuation of Mr. Worthington Smith's beautiful series of drawings. Perhaps the addition which will be first noted by the visitor is the splendid cycad recently presented by Mr. Horace Munn, of Jamaica.

CURRENT NOTES ON ANTHROPOLOGY.

RECENT STUDIES IN MAYA HIEROGLYPHICS.

DR. FORSTEMANN has added another (the 7th) instalment to his series 'On the decipherment of the Maya Manuscripts.' It is devoted to the interpretation of the upper portions of pp. 53–58 and lower portions of pp. 51–58 of the Dresden Codex. They are shown to be occupied with an attempt to obtain a common measure for the apparent years of the planets and the periods of the sun, moon and *tonalamatl*.

The same writer has in *Globus* (Bd. LXXIII., 9 and 10) a very able analysis of the Mayan calendar with reference to the gods governing the days (Die Tagegötter der Mayas). Most of the identifications will be accepted by scholars, though some still remain unknown or dubious.

In the *American Anthropologist* for April

Professor Cyrus Thomas has a critical review of Goodman's book on the 'Maya Inscriptions.' The reviewer points out the incorrect and unscientific character of most of the alleged discoveries, while recognizing that Mr. Goodman has shown for the first time that the periods are indicated on the monuments by symbols instead of by position, as in the codices, and has identified some of these symbols.

THE SCIENCE OF RELIGION.

THE first number has appeared of the *Archiv für Religionswissenschaft*, edited by Dr. Thomas Achelis, and published by J. C. B. Mohr, Leipzig (14 Marks). It is a well-printed octavo of 112 pages, containing original articles by Hardy, Roscher, Seler and others, and reviews of recent works. The editor is well and favorably known for his works on ethnology and special studies in comparative religion. The spirit in which the *Archiv* will be conducted is that of broad inductive research and modern philosophical investigation. The problem which will constantly be presented in connection with religious history will be psychological, that is, the critical analysis of religious development as exhibiting the general religious consciousness of the species.

The article by Dr. Seler is on an American subject—the derivation of certain elements in the myths of Central America. That by Roscher is on the significance of Pan in Greek mythology.

It is to be hoped that the *Archiv* will receive adequate support.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

IN a recent number of the *Comptes Rendus* A. Leduc has a paper on the composition of air at different places. His figures for the densities of different gases compared with oxygen agree very closely with those of Lord Rayleigh, but compared with air there is a constant difference, which amounts to about 0.0001. From this he draws the conclusion that the air of Paris contains 0.1 per cent. more oxygen than that of London.

The determination of the density of a gas has until recently been considered a difficult operation, requiring not only rather elaborate apparatus but a considerable quantity of the gas to be measured. Professor Ramsay has, however, shown in his work with argon and helium that it is possible to determine the density with accuracy with a quantity as small as thirty cubic centimeters. T. Schloesing, Jr., has now described, in the *Comptes Rendus*, an ingenious method devised by him which is simple, rapid, and accurate within 0.1%, and can be carried out with only a few cubic centimeters of gas. It is based upon balancing in a U-tube two gases, one of which is easily absorbable and whose density is known. After equilibrium is attained, the known gas is absorbed (as carbon dioxid by potash) in order to determine the invisible surface of separation. Very narrow tubes are used to reduce the unavoidable diffusion of the gases, and this has the advantage of reducing the quantity of gas necessary for determination. Hydrogen alone of gases yet examined diffuses too rapidly for the determination of its density. It would seem that this method will prove of great use.

ANOTHER paper from the *Comptes Rendus* should be noted in which D. Berthelot describes a new determination of the fusing points of silver and gold. A platinum-iridium thermo-electric cell was used for the purpose, and the melting-point of silver found to be 962° as an average of six experiments, while that of gold is 1064°. These figures are not far from those of Violle: silver 954°, gold 1035°; and the

earlier figures of Becquerel: silver 960°, gold 1092°. Among earlier observations for silver are Guyton de Morveau 1034°, Princep 1000°, Ledebur 960° and Daniell 1223°; for gold, Pictet 1100°, Pouillet 1200° and Wegele 1250°. The variation is not surprising when one considers the meagre means for determination at the hands of the early observer; it is rather surprising that they came so near the truth.

THE *Mitglieder-Verzeichniss* of the Deutsche chemische Gesellschaft for 1898 is just at hand and shows a list of 2989 members, making it the largest chemical society and perhaps the largest scientific society of the world. Its members are by no means confined to Germany, 1268 or over 42% being from other countries, so that it may almost be considered international in its scope. It also indicates the domination of Germany in chemistry. Almost every civilized and some hardly civilized countries are represented in its membership. This country has 285 members and Great Britain 232, these two furnishing over 40% of the membership outside of Germany. Next to these come Austria with 141 members, Switzerland with 131, and Russia with 118.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE WASHINGTON ACADEMY OF SCIENCES.

THE Washington Academy of Sciences adopted on March 29th the following schedule of functions:

1. The holding of meetings to receive the annual addresses of the Presidents of the affiliated societies.

2. The holding of meetings (*a*) to listen to scientific communications from prominent authorities specially invited for the purpose, and (*b*) to hear from selected members of the affiliated societies résumés of recent progress, statements of important questions pending in their respective branches, and other matters of general scientific interest.

3. The publication of proceedings in cooperation with the affiliated societies.

4. The inauguration of measures looking to the provision of a building for the use of the Academy and the affiliated societies.

5. The acquisition of a fund to be used in aid of scientific research.

The Medical Society has been added to the affiliated societies. The list of officers for 1898 is as follows:

President, J. R. Eastman.

Vice-Presidents: From the Anthropological Society, J. W. Powell; from the Biological Society, L. O. Howard; from the Chemical Society, H. N. Stokes; from the Entomological Society, W. H. Ashmead; from the Geographic Society, A. Graham Bell; from the Geological Society, Charles D. Walcott; from the Medical Society, S. C. Busey; from the Philosophical Society, F. H. Bigelow.

Secretary, G. K. Gilbert.

Treasurer, Bernard R. Green.

Managers: Class of 1901—Marcus Baker, Henry S. Pritchett, George M. Sternberg. Class of 1900—F. W. Clarke, C. Hart Merriam, Lester F. Ward. Class of 1899—Frank Baker, Carroll D. Wright.

THE HONORARY WALKER PRIZE.

IN 1864 the late Dr. William Johnson Walker gave to the Boston Society of Natural History a prize fund from which the Council of the Society may, not oftener than once in five years, grant a Grand Honorary Prize. This award may be five hundred or a thousand dollars, at the option of the Council. In previous years this prize has been awarded four times: first, in 1873 to Mr. Alexander Agassiz for his investigations into the embryology, geographical distribution and natural history of the echinoderms; secondly, in 1880 to Professor Joseph Leidy for his prolonged investigations and discoveries in zoology and paleontology; thirdly, in 1884 to Professor James Hall for his contribution to North American paleontology; and fourthly, in 1892 to Professor James Dwight Dana for his distinguished services in natural history.

At the meeting of the Council of the Society held April 20th it was voted to award the Grand Honorary Walker Prize of one thousand dollars to Mr. Samuel Hubbard Scudder, of Cambridge, for his contributions to entomology, recent and fossil. It is surely unnecessary here to dwell upon Mr. Scudder's life-long devotion to science. His contributions to the study of fossil insects of all orders and from all formations, and of the Orthoptera and the Lepidoptera, are

well known; his catalogue of scientific serials and his 'Nomenclatur Zoologicus' are equally well known and invaluable.

All scientific men will agree that in this award the Council of the Society has maintained its past high standard, and will join in wishing Mr. Scudder many years of health and vigor for the continuance of his work.

GENERAL.

The National Academy of Sciences held its annual stated meeting at Washington last week, beginning on April 19th. A report of the meet- will be published in the next issue of this Journal.

A special meeting of the Council of the American Association for the Advancement of Science was held in Washington on April 20th. President Gibbs presided and the Permanent Secretary and President-elect, Professor Putnam, reported on the arrangements for the Boston anniversary meeting. Professor McMahon, of Cornell University, was elected General Secretary in the place of the late Professor Kellicott. A large number of new members were elected, and routine business was transacted. Committees were appointed to consider revisions of the constitution and of the functions of the nominating committee made necessary by the amendments adopted at Detroit.

The University of Pennsylvania's Marine Biological Institute, on the shores of Ludlam's Bay, at Sea Isle City, N. J., is to be reopened this summer after being closed for five years. Dr. Milton J. Greenman, of the University, will have charge of the laboratory. A large floating house-boat is to be built for the use of students.

The French government has agreed to recommend an appropriation of 1,500,000 fr. for a building for the Paris Academy of Medicine. The Academy is at present very inadequately installed in the Charity Hospital. The new building will be on the rue Bonaparte.

The Committee on Science and the Arts of the Franklin Institute has recommended the award of the John Scott Legacy Medal and Premium to Messrs. Blondel and Psaroudaki for their invention of holophane globes. These secure diffusion of the light and an improved distribution so that the light usually sent off above the horizon is deflected downward to points where it is needed. These results are obtained by reflection and refraction, the globes being transparent.

The Gold Cothenius Medal, of the Leopoldinisch-Carolinische Akademie has been awarded to Professor Emil Fischer, of Berlin.

Dr. Nansen arrived in London from Christiania on April 11th. The visit is in order that he may complete the lectures which he was obliged to postpone last February on account of the illness of his infant son. After a week or so in the country he leaves for Vienna and St. Petersburg.

Dr. Frederic Peterson has been elected President of the New York Neurological Society.

We regret to record the sudden death from pneumonia of D. S. Kellicott, professor of zoology at Ohio State University and at the time of his death General Secretary of the American Association for the Advancement of Science. Professor Ernst Stöckhardt, formerly Director of the Agricultural Institute of Jena, died at Bautzen on March 27th.

The Philadelphia *Medical Journal* states that the Germans have been slower than others in adopting the Bertillon system of personal recognition by a series of measurements and the notation and registration of any natural pigmentary or hairy peculiarities. While the system is in use in France and very generally in Belgium, Switzerland, Russia and Italy, only isolated cities in Germany have adopted it. Some recent work with it at the prison at Moabit, in Berlin, has been encouraging, and now it is announced that the police departments of most of the South German towns are about to adopt it, Munich, Nürnberg, Regensburg, Augsburg and Würzburg having already made the necessary arrangements for its introduction.

It is against the etiquette of the medical profession to secure patents on medical discoveries and in Germany men of science hesitate to patronize the patent office. There does not appear to be such a decided objection to patents among British and American men of science. Lord Kelvin has, according to a paper read by

Dr. Magnus Maclean before the Philosophical Society of Glasgow, taken out 47 patents between the years 1858 and 1896. Of these patents 11 are for improvements in electric telegraphic apparatus, 24 for improvements in the control of electric currents, 10 for improvements in instruments of navigation and two for valves for fluids.

THE American Microscopical Association will hold its next annual meeting at Syracuse, N. Y., from the 30th of August to the first of September.

THE American Neurological Association will hold its twenty-fourth annual meeting in New York at the New York Academy of Medicine, on May 26th, 27th and 28th.

GOVERNOR BLACK has signed the bill authorizing The American Museum of Natural History, New York, to purchase and lease property.

THE appropriation of $25,000 made in recent years by the Legislature of the State of New York for the extension of agricultural teaching, under the auspices of Cornell University, has this year been increased to $35,000.

A DECREE has been published forbidding the importation into Austria of American fresh fruit, plants, fruit wrappers and fruit packings, etc., in cases where the examination at the port of entry results in the discovery of traces of the San José scale.

A NEW museum was opened at Keswick, England, on April 11th, being erected in memory of Thomas and Henry Hewitson, the donors of the Fitz Park. In an opening address Professor G. A. Smith, of Glasgow, spoke of the educational value of museums, and contrasted 'the keenness of America in this matter with the apparent backwardness of Great Britain.' We fear the compliment to America is scarcely deserved.

IN connection with the Trans-Mississippi Exposition in Omaha this summer, there is to be an Educational Convention on June 28th–30th. One of the features of this convention will be the Conference of Science Teachers. Arrangements have been made for papers on various sciences and elements in the curricula of the high schools, colleges and universities as follows: Astronomy—Professor Howe, University of Denver; Botany—Professor MacMillan, University of Minnesota; Chemistry—Professor Palmer, University of Colorado; Geography—Professor Haworth, University of Kansas; Physics—Professor Nipher, Washington University; Zoology—Professor Ward, University of Nebraska. Geology is still to be provided for. It is hoped to bring together a considerable number of Western teachers of science in this conference.

THE National Education Association meets at Washington on the 5th to the 12th of July. There is a Natural Science Section, of which Professor P. C. Freer, of the University of Michigan, is President, and Mr. C. J. Ling, of Denver, Colorado, is Secretary. On July 8th Professor Freer will make an address on 'The Relation of Natural Science Instruction in the High School to that in the University.' A standing committee, of which Mr. A. Smith, Chicago, is Chairman, will report on biological work in the high schools, and the training of teachers for work in science in the secondary schools will be discussed.

ACCORDING to the London *Times*, English interests were well represented at the recent International Congress on Commercial Education at Antwerp. The official delegates from Great Britain included Mr. T. King, Senior Chief Inspector of Schools, and Mr. R. L. Morant, representing the Education Department; Captain W. de W. Abney, C.B., F.R.S., and Mr. Gilbert R. Redgrave, representing the Science and Art Department; Mr. Woodall, M.P., and Mr. Swire Smith, members of the Royal Commission on Technical Instruction, and Mr. John Brigg, M.P., representing the County Council of the West Riding of Yorkshire. The London Chamber of Commerce was represented by Sir Albert Rollit, M.P., Mr. Frank Debenham and Mr. Montagu Barlow. The technical committee of the London County Council had also its representative, as likewise several of the provincial county councils. Some of the grammar schools, Bradford for instance, keenly alive to the value of attentively watching the debates, sent delegates to Antwerp. The Congress marked the 25th anniversary of

the foundation of the Students' Association fo the Institute, and the new school buildings were utilized for the proceedings. Among the papers discussed was one by Mr. E. E. Whitfield, of Galashiels, on 'Commercial Education in Great Britain.' The questions brought forward comprised the entire range of commercial education.

THE Section of Astronomy of the Paris Academy of Sciences has recommended the publication by the Academy of Pingré's 'History of Astronomy in the 17th Century.' This work has had a curious history. At the recommendation of Lagrange the Academy decided to publish it in 1791, and made an appropriation for this purpose. But owing to the death of Pingré and to the French Revolution the printing was suspended after some sheets had been prepared. Both these sheets and the balance of the manuscript have been lost for a hundred years, but now M. Bigourdan has discovered a single copy of the sheets in the hands of a French collector and the balance of the manuscript in the archives of the Paris Observatory, lost among observations of Tycho's. The work is said to be not only of historical interest, but also of value to contemporary astronomy in view of the careful observations that it records.

A VERY important contribution to the anthropology of European populations is promised for publication in the forthcoming *Comptes Rendus* of the Association française pour l'Avancement des Sciences. Dr. J. Deniker, librarian of the Musée d' Histoire Naturelle at Paris, will publish, with full bibliographic data, a large and detailed map of the cephalic index of Europe. This is based not only upon an exhaustive collection of published material, but upon much new data from Portugal, the Balkan States and other out-of-the-way regions, of which little has heretofore been known. This valuable work is to be followed by similar treatment of the stature and pigmentation as well, large maps in color having already been constructed for each characteristic.

DR. DANIEL G. BRINTON, of the University of Pennsylvania, read a paper entitled 'Before the Dawn—Literature Among Savage Tribes' before the members of the Comparative Literature Society, in Carnegie Lyceum, on April 9th. 'Thunder Cloud,' an Indian of pure American descent, elucidated Dr. Brinton's remarks by chants and recitatives in several Indian dialects.

THE Cartwright Lectures of the College of Physicians and Surgeons, Columbia University, will be given at the Academy of Medicine, New York, on Tuesdays, April 26th, May 3d and 10th, at 8:15 p. m., by W. W. Keen, M.D., professor of the principles of surgery and of clinical surgery in Jefferson Medical College. His subject will be, 'The Surgery of the Stomach.'

ON account of the frequent requests received at the Yerkes Observatory for lantern slides and prints from astronomical photographs, it has been thought advisable to make provision for supplying them. Mr. G. Willis Ritchey, Optician of the Observatory, who has had wide experience in making and copying astronomical negatives, has undertaken to furnish such photographs at moderate expense. He is prepared to supply lantern slides, transparencies and paper prints from any of the negatives in the collection of the Yerkes Observatory. Among the subjects available at the present time may be mentioned: Professor Hale's photographs of prominences, faculæ and other solar phenomena, and of stellar spectra; Professor Barnard's portrait-lens photographs of the Milky Way, nebulæ, comets and meteors; Professor Burnham's photographs of the Moon, Winter and Summer views of Mt. Hamilton and the Lick Observatory; Mr. Ellerman's photographs of the buildings and instruments of the Yerkes Observatory; and Mr. Ritchey's Kenwood Observatory photographs of the Moon. A more complete list of subjects may be had on applition to G. Willis Ritchey, Yerkes Observatory, Williams Bay, Wisconsin, to whom all orders should be addressed.

THE Vienna correspondent of the London *Times* telegraphs that some interesting particulars of a new application of the Röntgen rays for curative purposes were communicated by Dr. Edward Schiff, lecturer at the Vienna University, at the last sitting of the Imperial and Royal Medical Society. A series of experiments conducted by Dr. Schiff and his assistant proved

that these rays could be used for the cure of disease in a manner capable of perfect control by means of a more or less intense application for a longer or shorter period, producing reaction in the exact degree required. In this way it has been possible for the lecturer, on the one hand, to remove hair from parts of the body where it constituted a disfigurement without causing the slightest inflammation, while, on the other hand, he has been able to treat lupus with uniform success by means of an artificial inflammation, the intensity of which he was in a position to increase or reduce at will. The results secured by the new method both in the removal of superfluous hair and the treatment of lupus were demonstrated in the persons of some of Dr. Schiff's patients.

AT the annual meeting of the Michigan Board of Health on April 8th the President, Mr. Frank Wells, made an address, the greater part of which related to the outbreaks of typhoid fever along the St. Clair and Detroit rivers, at Port Huron, St. Clair, Marine City, Detroit and Wyandotte, especially the recent one at the city of St. Clair. He was emphatic in his belief that the Board should enter upon a more thorough investigation of the waters of St. Clair river, with a view to ascertaining, if possible, where, when, under what circumstances, and how the river is contaminated, whether the contamination is intermittent or constant, what is the result of dredging the sewage sludge out of Black river at Port Huron, and whether the contaminations which constantly enter the river at Port Huron find their way into the water supplies of the cities along the river, and under what circumstances such contaminating material finds its way into the water supply of Detroit. The questions are of vital importance to the citizens residing along the St. Clair and Detroit rivers, and such investigations would be of inestimable value. The President said he knew that the funds at the disposal of the State Board were inadequate, but he hoped that the Board would see its way clear to pushing the investigation at least far enough to learn the importance of such work, when if it proves to be as important as he thought, the Legislature would undoubtedly do as they have in other States, make provision for having the investigation properly made. The Secretary of the Board mentioned that he had had several samples of water from the river examined, from the river as it leaves Port Huron, from the river opposite the intake at St. Clair, from the water works in St. Clair, from a tap in St. Clair, and from the river as it leaves St. Clair. All of the samples were found to be contaminated.

THE following note from our literary contemporary, *The Critic*, may prove of interest to men of science: "One might enjoy the humor injected into the situation at the Castle Garden Aquarium, if it were not such a direct menace to the best interests of that admirable institution. If Col. James E. Jones has said all the things attributed to him by the papers, and there is no reason for doubting that he has, he should be keeping a fish-stand in Washington Market, rather than managing an aquarium that is designed to be of scientific benefit to the public. His predecessor, Dr. Bean, knew his business, and managed the interests of the Aquarium as it was intended they should be managed. He was not a Tammany man in politics nor in his methods. Hungry Tammanyites were after the office, however. Mr. Croker is said to have hinted to Dr. Bean that his salary was wanted for another man, but he refused to take the hint. Tammany has an excellent plan for securing any salary that it wants for its own people, when it cannot oust the person who is drawing it. The office is abolished—and afterwards re-created. The Tammany man is then put into the newly-created office, and all goes well—that is, as far as he is concerned; but it goes very ill for the public. Most of us thought that Dr. Bean was the right man in the right place, but we are told by his successor that he was 'too damn scientific to run an Aquarium.' That was a new view of the situation. Col. Jones has expressed other views quite as new and startling. He may know a hawk from a hern-shaw, but he tells us quite frankly that he does not know much. He said to a *Times* reporter:

"Take those specimens of sea anemones, for instance. They're out there in the laboratory, and few know anything about them, and more care less. What

are they, a fish or a vegetable? I'm darned if I know, and I guess there are a whole lot like me.

"Col. Jones also confesses to being a 'jollier,' but adds that he will curb his 'jollying' habit for a time at least, and attend to business. His favorites in the Aquarium are the seals, because they are 'just too funny for anything,' particularly one who 'squirts water over people.' Are they, I should like to know, any funnier than Col. Jones? He has said enough to cause his instant dismissal by any other government than one that made its way into power with the battle-cry, 'To Hell with reform.'"

A scientific expedition under the direction of Dr. Nordenskiöld has been organized in Sweden to explore the Klondike region. The expedition, the expenses of which will be defrayed by Mr. Elk, director of a large banking house in Stockholm, was expected to leave Sweden on March 23d. Dr. Gunnar Andersson, docent in geology in the high school at Stockholm, will accompany the party, which is expected to be absent about two years.

The Government Statist of Victoria estimates the population of the Australasian colonies at the end of 1897 at 4,410,124. When the census of 1891 was taken the numbers were 3,809,895, so that there has been an increase since then of 15.75 per cent. The population of Victoria is estimated at 1,176,238, an increase of 35,833. The births exceeded the deaths during the period by 127,418, but the loss by emigration 91,000. The increase per cent. in Victoria was 3.14; in New South Wales, 16.89; in south Australia, 13.29, and in Western Australia, 225.23.

The Council of the Imperial Institute have authorized the holding of an exhibition of acetylene-gas apparatus in the grounds of the Institute at an early date, and, in order to ensure that no apparatus should be admitted to the exhibition unless it was shown to fulfil the requisite conditions of safety, the Council of the Society of Arts have appointed a committee to decide upon those conditions and to lay down rules for the admission of apparatus. The following gentlemen have been appointed to act on this committee: Major-General Sir Owen Tudor Burne (Chairman of the Council), Sir Frederick Bramwell, Professor James Dewar, Mr. Harry Jones, M. Inst. C. E., Professor Vivian B. Lewes, Professor Boverton Redwood, Professor W. C. Roberts-Austen, Professor J. M. Thomson and Sir Henry Trueman Wood (Secretary). Full particulars will shortly be issued as to the regulation and rules laid down.

A few weeks hence, says the London *Times*, work will be begun upon an important new building in the neighborhood of Dulwich—the Horniman Free Museum, which its founder, Mr. Frederick J. Horniman, M. P., intends to present as a free gift to the inhabitants of that neighborhood. The new building will consist of two galleries, each upwards of 100 feet long, lighted from the top. In addition, there will be a large lecture-hall having a seating capacity for 300 persons. Altogether, the museum, including the administrative block, will be some 300 feet in length, and will present a very handsome appearance, its front being constructed entirely in stone, with a clock tower of striking design, over 100 feet in height. The galleries will be divided into various courts, each devoted to a separate class of the interesting objects of which the museum proper consists. Thus there will be a pre-historic court, an Egyptian court, an Indian court, a colonial court, a Japanese court, and so-forth, while there will be special departments for the zoological and entomological specimens as well as for the large library. During the last 35 years Mr. Horniman has been acquiring the freeholds of the various properties adjacent to the house in which, for seven years, his collection has been on public view. The 15 acres so acquired he intends to convert into a public park and recreation ground, while Surrey Mount, an existing mansion therein—from which is to be obtained one of the finest views in the district—is to be fitted up as a free library and club house, separate rooms being devoted to the free use of the scientific and other clubs in the vicinity. The new museum, of which Mr. C. Harrison Townsend is the architect, will be within three or four minutes' walk of Lordship-lane and Forest-hill railway stations, and will thus be in the center of a rapidly extending neighborhood.

Since Mr. Horniman's collection was opened to the public, seven years ago, more than 455,000 people have visited it in its temporary home.

AT a meeting of the Trades League of Philadelphia on April 14th the following resolutions were adopted:

WHEREAS, There is at the present time no general system of sanitation and disinfection throughout the United States, guided and controlled by one general head and working in harmony with local and State Boards of Health ; and

WHEREAS, The presence of an epidemic of contagious diseases in any part of the country without such general system of control breeds fear and panic, from a lack of confidence in the ability of the local Board of Health to control the epidemic within a contracted radius of territory ; and

WHEREAS, Localities within hundreds of miles of the infected district quarantine against it and other places near it, thus resulting in enormous losses to commercial and transportation interests of the country at large ; therefore, be it

Resolved, That the Trades League of Philadelphia, an organization of nearly two thousand business firms, earnestly recommend the establishment, by the National Government, of a commission of public health, to be known as the 'National Commission of Public Health,' which shall be a bureau in the Treasury Department, and the duties of which shall be to collect and disseminate information with regard to the prevalence of infectious diseases in this and other countries, to collect and publish vital statistics, to prepare rules and regulations for securing the best sanitary conditions of vessels from foreign ports and for preventing the introduction of infectious diseases into the United States and their spread from one State or Territory or the District of Columbia, and, in general, to make investigations, publish information and formulate rules with a view to the preservation of the public health.

Resolved, That the Legislative Committee of the Trades League shall give the subject their careful and prompt attention, with 'power to act' as the importance of the subject may demand.

IN a recent lecture at the Royal Institution, London, on some analytical uses of liquid air, Professor Dewar stated, according to the account in the London *Times*, that low-temperature work has been greatly extended of late, and that both on the Continent and in America there had been a large development in the applications—or projected applications—of liquid air. He proceeded to explain the use of this agent for the qualitative separation of the gases composing a mixture, and practically illustrated the method with a sample of the gas given off by the Bath springs, which was thus shown to contain argon, helium and a hydro-carbon that was liquid at ordinary temperatures. Referring to the cessation of chemical action with extreme cold, he said that photographic effects alone persisted, but had lost some 80 per cent. of their intensity. It was a curious fact that the photographic activity of ultra-violet light, though the greatest at ordinary temperatures, suffered most diminution at low ones. In conclusion the lecturer spoke of the thermal phenomena presented by the vacuum jacketed vessels, of which he introduced the employment. Pictet after an elaborate investigation concluded that below a certain temperature all substances had practically the same thermal transparency, and that a non-conducting body became as ineffective as a conducting one in shielding the vessel from heat. But Professor Dewar's experiments showed that such was not the case, the transference of heat observed by Pictet appearing to be due not so much to the materials themselves as to the air contained in their interstices. By filling the annular space between the walls of several similar vacuum vessels with various substances and exhausting them all equally of air, he found large differences in the thermal transparency of the substances, as measured by the rate of evaporation of liquid air contained in the tubes. Moreover, the thermal transparency of some materials diminished at very low temperatures instead of increasing, as had been asserted to be the case. Thus, of two vacuum tubes, one simple, the other having powdered carbon in the vacuous space, the latter at low temperature was the more efficient preserver of a liquid air, showing that the carbon diminished the radiation. But when the vacuum was destroyed and warm air admitted into the space, the liquid in the carbon tube boiled off much more vigorously than that in the simple tube, indicating that at an ordinary temperature carbon allowed more heat to pass than did air.

ONE of Dr. Linde's machines for the liquefaction of air, says the London *Times*, has been

exhibited at work in the rooms of the Society of Arts. Its action is based on the fact that air, not being a 'perfect gas,' is reduced in temperature when suddenly allowed to expand through a narrow orifice from a high to a low pressure. The slight cooling effect thus obtained is rendered cumulative by the cooled air being used to abstract heat from the air that has not yet passed the orifice. Each successive portion of air is, therefore, cooler when it reaches the orifice than was its predecessor, and thus in time so low a temperature is reached, provided due precautions are taken to insure thermal isolation, that a change of state occurs and air appears in the form of liquid. The particular machine on view circulates each hour about 15 cubic mètres of air, which is expanded from a pressure of 200 atmospheres to one of 16, and produces about 1.9 litres of liquid air an hour with a continuous expenditure of three-horse power. Although the oxygen and nitrogen of the atmosphere liquefy simultaneously, still the latter evaporates more quickly, and this fact can be utilized to obtain a liquid which is very rich in oxygen. An interesting application of liquid air containing 40 or 50 per cent. of oxygen has recently been made. Mixed with powdered charcoal it forms an explosive which is comparable in power to dynamite, and which, like dynamite, can be made to go off violently by using a detonator. Trials which have been carried out with this material in a coal mine at Penzburg, near Munich, are claimed to have given very satisfactory results. The explosive is cheap, its cost being practically that of liquefying air; but, of course, owing to evaporation, it is only capable of exploding for a few minutes after being mixed.

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT DWIGHT, of Yale University, has published his annual report. He suggests suitable gifts to the University amounting in value to over $3,000,000, which he hopes may be secured in celebration of the coming bi-centennial. The value of the Lampson bequest is stated to be upwards of $400,000. President Dwight especially dwells on the need of a building for the work in physiological chemistry, the need of $150,000, which, with the existing fund of $100,000, will make possible the completion of the Peabody Museum and the desirability of enlarging the observatory. The library acquired by purchase during the year 7,840 volumes and by gift 1,385 volumes, and the pamphlets added to the library were 6,300 in number. During the past ten years the teaching force of the University has increased from 43 to 102.

THE Board of Overseers of Harvard College have adopted the following resolution:

Resolved, That the overseers will see with pleasure the admission requirements of the Lawrence Scientific School brought as rapidly as circumstance may permit to substantial equality with those of Harvard College, provided that, in so doing, the standard for admission to the Scientific School shall be steadily raised, and that for admission to the College in nowise lowered.

THE New York State Department of Public Instruction has decided to hold four summer schools this year for the teachers of the State. The past two years two schools have been held, at Chautauqua and Thousand Islands Park. The two additional schools will be held at Greenport, Long Island, and Ithaca.

THE West Virginia University has established eleven fellowships yielding $300 yearly and free tuition. The fellows are expected to teach one hour a week or give two hours' supervision in the laboratory. In the eleven subjects for which the fellowships are awarded, the sciences are well represented, they being as follows: Chemistry, Physics, Geology, Zoology, Botany, Mathematics, Mechanical Engineering, Civil Engineering, Economics, English and Greek.

THE estate of Mrs. Julia W. James, of Boston, divided by her will between the Museum of Fine Arts and the Massachusetts Institute of Technology amounts to over $500,000.

AT Harvard University Mr. S. I. Bailey has been promoted to an associate professorship of astronomy and Dr. W. T. Porter to an associate professorship of physiology.

DR. NORMAN WILDE, assistant in philosophy in Columbia University, has been appointed instructor in philosophy in the University of Minnesota.

THE John Tyndall Fellowship of Columbia

University for the encouragement of research in physics has been awarded to R. B. Owen, a graduate of the School of Engineering and professor of engineering in the University of Nebraska. Of the twenty-four fellowships annually awarded, the following fall more immediately within the field covered by this JOURNAL: T. E. Hazen, botany; B. H. Owen, philosophy; J. D. Irving, geology; E. Kasner. mathematics; W. C. Kretz, astronomy; J. W. Miller, Jr., mechanics; F. C. Paulmier, zoology; F. J. Pope, chemistry; C. E. Prevey, statistics; R. S. Woodworth, psychology.

HERR KRUPP has given 20,000 M. to the Institute of Physical Chemistry at Göttingen.

A COMMISSION of ten members of the Paris Municipal Council has been appointed to study the relations between the city and the University.

SOMETIME since we called attention to the decree excluding foreigners from the engineering departments of the Berlin School of Technology. The *Scientific American* quotes some German opinions of the subject. Thus the *Deutsche Zeitung* remarks: "At the non-Prussian high schools at Munich, Dresden, Stuttgart, Carlsruhe, Darmstadt and Brunswick there are 1,200 foreigners out of 8,682 students. We hope that, as the foreigners use their knowledge to the detriment of German industry, the non-Prussian governments will forthwith exclude them." It is learned that for some time past there has been an exchange of views between Prussia and the other German governments on this subject, and there is no telling how soon the policy may become general throughout Germany. The following expression by a high German official indicates the feeling on the subject: "There is no question that the German technological schools and industrial and scientific institutions will soon be forced to adopt a less liberal policy with foreigners. The tricks of trade we have been teaching them so long are now being used against us to the great injury of our industry."

DISCUSSION AND CORRESPONDENCE.

COLOR VISION.

IN a paper upon Color Vision, published in SCIENCE, April 15, 1898, Professor W. Le Conte Stevens deplores the unsettled state of psychological opinion on matters of visual theory. "The bewildered physicist * * * * despairingly beseeches the psychologists to agree among themselves, but they will not agree; on the contrary, the prospect seems to be that additional color hypotheses will continue to appear until from their abundance they cease to receive attention." In the present article I hope to be able to show that the psychology of Color Vision is not quite so chaotic as to Professor Stevens it seems to be.

First of all, however, I desire to express my appreciation of the courtesy and frankness with which the author's challenge to the psychologists is made. The work of scientific men to-day is very highly specialized, and it taxes one's energies to the utmost to keep abreast of the movement of thought in one's own special province. Nevertheless, we are all, to some extent and in certain cases, dependent upon our neighbors; we must at times make excursions into adjacent scientific fields. Here, then, is a great difficulty. If we stay at home we fail of knowing something that we ought to know; if we travel into another domain we are apt to go astray. We have no perspective in the unfamiliar science; we cannot distinguish the important from the unimportant; our reading of the literature has been intermittent and perfunctory. However earnest our attempt to find out what is doing next door, its result must oftentimes be a personal bewilderment and confusion, which we may very easily make objective and ascribe to what is in reality a perfectly orderly household. I have sometimes left the study of a disputed point in nerve physiology with the feeling that the whole issue was a matter of the merest conjecture; but a subsequent talk with a working neurologist has given me a scale of values, and indicated definitely enough to which side the balance of probability inclined.

Professor Stevens, writing as a physicist, gives up the psychological problem of Color Vision, and calls upon the psychologists to settle the question for him. We cannot quite do that, because Color Vision is, and will for some time remain, debatable ground. But we can, returning his candid appeal an equally candid answer, give him the clue to the maze of hypothesis, or,

to take up the former metaphor again, show him the competing theories in their right perspective.

It may be said, without any hesitation, that there are now only two discussable theories of Color Vision, those of Helmholtz and of Hering. The theories of König, von Kries and Mrs. Ladd Franklin are simply improvements on (or modifications of) the 'tri-component' theory of Helmholtz. The theories of G. E. Müller and of Ebbinghaus stand in a like relation to the 'antagonistic color' theory of Hering. I will say a few words upon both theories.

I. The Helmholtz theory.—This theory was devised to explain 'the phenomena of color mixture and color analysis' (Stevens, p. 520). It does explain them, admirably; it explains nothing else. It breaks down in face of the facts of color blindness, of indirect vision, of after-images and contrast, of the Purkinje phenomenon, etc. Hence, its original and most attractive simplicity (p. 516) has been given up in favor of König's shift of excitability in the three elementary substances, von Kries' double white-process (one-fibre white and three-fibre white), and Mrs. Ladd Franklin's hypothetical molecule of suicidal tendency. All these modifications are of the nature of subsidiary or 'bolstering' hypotheses; each of them has had grave experimental objection urged against it.

II. The Hering theory.—"The Hering hypothesis," says Professor Stevens, "is well known and probably universally rejected among physicists." The latter part of this statement I believe to be substantially true; the first half I must take leave to doubt. Hering's theory in its modern form has nowhere received complete exposition. Indeed, if Professor Stevens has not, in the course of his psychological reading, come upon Ebbinghaus' theory, which is readily accessible in a recent volume of the *Zeitschrift für Psychologie*, the conclusion is almost forced upon one that he has not himself followed up the Hering theory in its meanderings through a large number of scattered journals, some of which are now not at all easy to procure. A brief account of my own experience may, perhaps, serve to justify the bluntness of this remark. Until recently there was one weak point in the Hering theory which absolutely forbade its acceptance by the psychologist. Having satisfied myself that this defect was really fatal to the theory, I was content for several years to know only the general accounts of it given, *e. g.*, in Helmholtz's *Optik*, Wundt's *Physiologische Psychologie*, Hermann's *Handbuch*, Hering's own *Zur Lehre vom Lichtsinn*, etc. Not till the publication of Müller's article, which removed the difficulty, did I make any serious effort to gain a thorough understanding of Hering's point of view. And if the psychologist is thus remiss, what can be expected of the physicist?

Hering's theory is, in actual fact, every whit as adequate to the phenomena of color mixture as is that of Helmholtz. It also offers a self-consistent explanation of the other phenomena referred to above. It has, further, on more than one occasion, been led to predict a certain state of sensitivity or sensible discrimination, and its predictions have been verified. I do not know what more can be demanded of a psychological theory. The objection to it was that the concept of antagonism was used in one sense for red-green and blue-yellow, and in another, quite different sense, for black-white; but Müller has demonstrated that the black-white antithesis may be of precisely the same nature as the other two, despite the existence of the sensation gray. Ebbinghaus' theory (which is, by the way, a model of expository method) attempts to find an anatomical substrate for the three visual substances of the 'antagonistic color' theory.

I have so far said nothing of Wundt's theory. This, the periodicity theory, did not, of course, originate in the *Philosophische Studien* article to which Professor Stevens refers; it antedates Hering's *Zur Lehre*, etc. (see *Phys. Psych.*, 1874, p. 388; 1880, p. 452). It arose by way of reaction against Helmholtz, and has the merit of possessing an independent white-process. But, though it covers all the facts, it covers them too loosely to serve as a genuine working hypothesis. Hence it has never succeeded in getting itself discussed. It was an excellent makeshift so long as definite factual objections could be urged against Helmholtz and Hering

alike; it loses its value as soon as we have a more explicit theory which leaves no important fact of psychological optics outstanding. I cannot at all assent to Professor Stevens' assertion that the theory 'has a good following among psychologists.'

M. Nicati's theory is contained in a single forty-page article, which has not as yet received the compliment of an abstract in the *Zeitschrift*, or the *Année psychologique*. M. Nicati and Professor Patten have, as Professor Stevens says (p. 515), a perfect right to the enunciation of their hypotheses if they believe that these add to the intelligibility of the observed facts. But the hypotheses must be worked out in fiftyfold greater detail, and set upon a fiftyfold wider basis of observation and experiment, before they cease to be the private property of their authors and command general attention. The psychologist must know them in the sense that he must know his literature at large. He is no more disturbed by them, however, than is the biologist by the thousand and one theories of heredity and transmission that have been formulated since the days of pangenesis.*

In conclusion, I must ask Professor Stevens and other readers to excuse the dogmatic tone of this communication and to attribute it to limitations of space. References could be given for every statement. I may add that my own conversion to the Hering theory has been exceedingly gradual, the result of a systematic working-through of argument and counter-argument, under experimental control; and that, so far as I am aware, I have absolutely no bias in favor of any theory. There are three or four other theories of vision, not mentioned in these two papers, which I should rate higher than either that of M. Nicati or that of Professor Patten. Psychologists should be grateful to Professor Stevens, not only for raising a general question which concerns both physics and psychology, but for his 'physical' criticisms upon the Helmholtz theory.

E. B. TITCHENER.

* M. Nicati's hypothesis posits a primary gray-vision, and proceeds with a tri-component color theory on an electrical-physiological basis. It is apparently a remote offshoot of the Helmholtz theory.

THE DEBT OF THE WORLD TO PURE SCIENCE.

TO THE EDITOR OF SCIENCE: Professor Stevenson's admirable address, recently published in SCIENCE, calls to mind the sometimes forgotten fact that there are still those who in considering the labors of science, scornfully ask: "What is the use of all this?" Of all forms of scientific propagandism the exhibition of specimens in a scientific museum might seem least likely to bear fruit to financial profit. That even here, however, the practical benefits of science can be demonstrated, the following examples that have recently come under my observation may be cited. They are of no great consequence themselves, but illustrate a principle which undoubtedly has wide application and, coming to my notice quite by chance, are probably typical of hundreds of similar instances which occur.

A government contract was to be let for the building of a breakwater. The filling was required to be rock of a certain toughness and durability. The local contractors, with a unanimity born either of accident or design, declared that it would be necessary to go more than a hundred miles to obtain such rock and a railroad would have to be built to transport it. Their estimates of the cost of the work were made accordingly. There was not time for contractors at a distance to explore the region, but one contractor, living two thousand miles away, sent a prospector about in the vicinity of the proposed work, with instructions to forward him samples of such rock as might be suitable for the work, with information as to the quantity of each in sight. These samples the contractor brought to a museum, and by comparison with the specimens there, and consultation with the Curator, learned that one of the rocks collected possessed the required qualities. He also learned that the quantity was probably assured by the fact that it was an eruptive rock of which more could be obtained by deeper quarrying. Relying on this information, he made a bid on the work at a price $75,000 lower than any of the other contractors had done. The information he had gained may be credited with having saved the government that amount.

A company endeavoring to sell stock in a

Western mine distributed, as one of the products of their 'Holy Terror,' specimens which they denominated metallic cobalt. The substance looked metallic enough, and local assayers being unable to deny their statement the shares found ready sale for a while. But after a time one doubting Thomas brought his specimen to a museum to see if by comparison with anything there he could establish its cobaltic character. A little comparison showed him that his specimen was carborundum, and carborundum he learned was not made by the reduction of cobalt ore. Whether he imparted this information to others who thought of purchasing shares I do not know, but it is likely that the output of carborundum from cobalt (?) mines received a serious set-back after his discovery.

A Canadian prospector working in a little-explored region found a deposit which for some reason he believed to be zinc ore. He was so well convinced of this that he made his way to a large city for the purpose of obtaining means to work the ore. Visiting a museum where specimens of zinc ore were exhibited, he compared them with his own and at first concluded that the two were identical. On looking further, however, he saw specimens of septaria, which he at once recognized as representing his own specimens. His dreams of a zinc mine were dissipated, but that the awakening had come before he had expended his own and other's means was due to his improving an opportunity to consult an accurately classified and identified, in other words, a scientific collection.

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FIELD COLUMBIAN MUSEUM.

SCIENTIFIC LITERATURE.

Darwin, and After Darwin. III. Post-Darwinian Questions, Isolation and Physiological Selection. By the late G. J. ROMANES. Chicago, Open Court Pub. Co. 1897.

The writings of the late Dr. Romanes are always interesting, whether one agrees with his conclusions or not. The present volume deserves to be widely read by naturalists, not only as a clear exposition of its author's views on evolution, but as an admirable stimulus to thought and observation. Dr. Romanes, in the closing years of his life, did all he could to bring about the foundation of an establishment for testing experimentally the various hypotheses concerning evolution, but without much success. A few observers have been doing excellent work, but the great majority of working naturalists appear to pay little attention to theoretical considerations, and so lose the opportunity of contributing valuable evidence to throw light on controverted questions.

Under the heading of Isolation it is set forth that this may be of two kinds. In *Apogamy*, or indiscriminate isolation, certain individuals are isolated from their fellows without regard for any peculiarities they may possess; in *Homogamy*, on the other hand, the isolated individuals are isolated because they differ from the rest. Natural selection gives rise to *Homogamy* by preserving certain individuals having desirable peculiarities, thus isolating them from those which, lacking those characters, perish. Any form of *Homogamy* must cause a change of type, and thus constitutes a step in evolution. *Apogamy*, strictly speaking, would not cause any change; but as no two portions of a species are entirely alike, in practice it becomes converted into a slight form of *Homogamy* and in time change results. This is most likely to occur when the separated portion is very small, as the average of a few individuals is less likely to resemble that of the whole species than the average of, say, half the species.

It is set forth that there are two forms of evolution, the *monotypic* and the *polytypic*. Natural selection, it is stated, can only cause monotypic evolution; therefore to explain the multiplication of species in space we must call in the aid of other forms of isolation. One potent cause of isolation is said to be *Physiological Selection*, *i. e.*, the segregation of sets of individuals which are fertile with one another, but wholly or partly sterile with the rest of the species.

All these matters are discussed in detail, with many quotations from previous writings. On p. 41 it is remarked that "against the view that natural selection is a sufficient explanation of the origin of species there are two fatal difficulties: one, the contrast between natural

species and domesticated varieties in respect of cross-sterility: the other, the fact that natural selection cannot possibly give rise to polytypic as distinguished from monotypic evolution." The author adds: "Now it is my belief that the theory of physiological selection fully meets these difficulties."

To the present writer, these objections to the sufficiency of natural selection seem not to carry weight, but the matter can only be suitably tested by observation. In the first place, it remains to be shown that polytypic evolution, in the sense intended by Romanes, occurs commonly in nature. Cases are cited in which different species of plants appear to be originating in the same area, but it is by no means proven that they did not originate in different localities and have since intermingled. And even if they have been confined from the beginning to an apparently uniform environment, it will be very hard to prove that the uniformity is real, so that there is no opportunity for natural selection to act differently on the different parts of the original species. It seems to me that, given diverse conditions of life within a limited area, natural selection may operate not only to bring about the division of a species into two or more, but also sterility between them. Let us take the case of such grasshoppers as are found on the sandhills of New Mexico. Some are green and live on the herbage; others are light brown, the color of the ground on which they commonly rest. Each kind will gain some advantage from its color, combined with its habits. Suppose that these are still mutually fertile varieties of one species, the greenish and brownish specimens will cross, and the formation of two races will be hindered.* But there will be variations in fertility, and those which are most fertile together, and at the same time of identical colors, will have an advantage. Hence the correlation of, say, greenness with certain variations of the reproductive organs, will be seized upon by natural selection and perpetuated. Even in ordinary monotypic evolution those individuals which are specially fertile *inter se*, or infertile with those unlike them, and *at the same time possess beneficial characters*, will have an advantage, and the peculiarites of the reproductive organs will be increased through natural selection. Another case is that in which two varieties, mutually fertile, have originated in different localities, but afterwards occupy the same territory. When they meet (as has been actually observed in some cases) hybrids, or mongrels, will be formed all along the line, and it appears as if the peculiarities of each form will eventually be lost. But any small percentage of either variety which has in common some variation of the reproductive organs, leading to physiological isolation, will be left alone to represent the original variety; and as that variety is fitter to survive than the mongrel it will supplant it, and we shall have a species which is infertile with its allies. That it will be infertile with all, or nearly all, its allies is probable because the variations of the reproductive organs are so numerous and so diverse that it is not likely that exactly the same sort of variation will be selected in any two cases.

* Unless there arises a green and brown dichroism within specific limits, as in one species known.

Thus, while natural selection might employ physiological (more properly, sexual) isolation in the formation of species, it is not quite apparent to me that such isolation would of itself cause divergence. For while sexual isolation would be homogamy as regards that variation —which is by itself the reverse of beneficial—it would be apogamy as regards other variations, since it is not shown that it is correlated with any particular modifications of other kinds. So the isolated individuals, having no advantage, but some disadvantages from their isolation, would tend to be eliminated rather than to increase, owing to the operation of natural selection.

As telling against the necessity for natural selection in the formation of species, Mr. Gulick's statements regarding the land-shells (Achatinellidæ) of the Sandwich Islands are quoted. In these islands it appears that almost every valley has a distinct variety or species, and yet the conditions of existence are apparently the same in at least many of the localities.* Mr. Gulick considers

* I have never been to the Sandwich Islands, but can testify that in Jamaica, which also has a remarkably varied molluscan fauna, there are many different conditions of soil, moisture, vegetation, etc., consti-

the distinctions to be due to isolation, without any reference to utility. Suppose a variable type to occupy a valley, A. A few examples wander to valley B and start a colony. Their average is not the same as that of the whole population of the place whence they came; hence the colony will differ more or less, from the start, from the parent race. If this difference is not harmful it will be perpetuated.

The proposition that natural selection can have nothing to do with these changes seems to need examination. It is possible, for example, that when birds have got used to eating variety A in valley A they will not so readily observe and attack a different variety in the neighboring valley B. On crossing into B they might certainly be expected to look for and first attack examples similar to those they had before eaten; hence the new variations would be neglected and get some advantage. Another point is that in a variable species certain individuals will be selected by reason of characters which are, perhaps, not visible externally, *e. g.*, the ability to digest a new sort of food. When these individuals are selected out of many, in the home of the species, they will probably be of diverse varieties, and so no special color-strain, for example, will arise. But let a few examples migrate, and of these only a few survive, it is probable that these survivors will have correlated with their useful characters certain others which are not in themselves valuable.

Much more might be said, but these few criticisms will serve to indicate the problems discussed in the work; and, it is hoped, to suggest lines of observation to those who can help to give us knowledge in place of hypotheses.

T. D. A. COCKERELL.

MESILLA PARK, NEW MEXICO,
March 25, 1898.

tuting different environments for the snails. The Sandwich Islands are elevated, and it is quite certain that the greatest precipitation of moisture must occur at the higher levels, and on the side of the islands first reached by the prevalent winds. On sloping ground there must also be marked differences of sunlight; and, in short, it may be regarded as certain that the Sandwich Islands valleys do not offer identical conditions.

Penikese; a Reminiscence by One of Its Pupils. Albion, N. Y. 1895. Pp. 95. Price, $3.00.

This is a work dedicated by an unknown author 'To all to whom the memory of Penikese and its Master is dear.' We note in the preface that 'the material of which this little volume is composed furnishes the apology which its author would make for its appearance,' and that 'it seems best no longer to withhold its pages from the public.' The material does not furnish an apology; what the public has done to provoke its publication is not stated, and unsuspecting librarians who may be inspired with everything that bears the name of Penikese should hesitate before placing their orders.

The first chapter, 'The Journey,' is largely devoted to a description of a New England hay field and the antics of a sunbeam in an obscure New Bedford hotel. In the second chapter we learn how 'two score and ten specialists' met together 'on this desolate island,' how they scrambled for their baggage, and how the author took a nap, and what he dreamt, on the afternoon of his arrival. In chapter five the general details of the laboratory are discussed. The author tells us that there were 'bottles of alcohol, sea water, glycerine and other preserving fluids;' how there were 'the remains of a skate fish with the brains exposed' to show 'the five pairs of nerves and their surroundings exactly as they exist in nature;' how the snails 'lay their eggs, in large numbers, bunched together and sticking to each other;' how 'snails' eggs are opaque and white, being longer than broad.'

Writing of one of the leading naturalists, the unknown author says: "Sometimes he tells us about that most wonderfully curious appendage of the bivalves or the lamellibranchs, the crystalline style, and of how it has no attachment to body; this leads to an investigation, and our discoveries are marvelous."

Further on we read as follows: "Ciliary motion ten foot square would exert a force equal to ten tons." * * "One species floats on the surface of the ocean when it is calm. * * specimens, *specimens*, *specimens*, EVERYWHERE. Our professors lecture to us of nothing else; our time is spent in securing and dissecting them." * * "It is from such sketches of our lectures as

those just given that the reader will obtain a glimpse, faint and imperfect though it may be, of a single day's doings at Penikese."

The description of the Physalia is unique and especially good: "As we have no specimen before us, let us try, through the medium of the '*dead* languages,' a little induction *a posteriori*, and discover, if we can, *what* our specimen is really like."

"At first sight, the Portugese man-of-war would put one in mind, as the name suggests, of an immense bubble of air." * * "It stings us with an electric stroke." * * "The true home of this living, floating island is in the Gulf of Mexico," etc. The author says he found a specimen, which 'threw off a whole tankful of young, which went paddling around everywhere of their own free will, as happy as clams at high water.'

Aside from a few errors in spelling and the misstatement of a few well-known historical facts, we offer no further adverse criticism, though in closing we cannot refrain from quoting from page 64, where the author says: "Well do I remember how often Professor Agassiz urged us to read only the best of books." * * * "He cordially detested the ordinary books upon scientific subjects. At one time, in a paroxysm of rage at these 'would-be scientists,' he exclaimed: 'They are mere compilations of persons unfamiliar with science, who mix the false and the true.' Alas, shall we ever again meet with his equal, as teacher and pupil and brother combined!"

H. C. B.

NOTE: Since writing the above review we have examined an advertising circular which announces 'A Memorial Volume of Penikese,' the same as the above mentioned work. We quote from this circular as follows: "About two years ago I completed a contract for the printing of my 'Penikese Island;' unfortunately, before the pages were finished, the parties with whom I contracted became bankrupt. I have just succeeded in rescuing the sheets from the wreck at an expense of something over $100. The work is in signatures, is on tinted paper, hand-made expressly for the purpose, comprises about 100 pages, and only 100 copies were printed. These will be sent to the old teachers and scholars and their friends only if they can be found. Price, postpaid, $3.00. Send check or postal order to W. A. Stearns, Atlanta, Ga."

Exploration of the Air by Means of Kites. I. *Kites and Instruments*, by S. P. FERGUSSON. II. *Results from the Kite Meteorographs and Simultaneous Records at the Ground.* III. *Discussion of the Observations*, by H. HELM CLAYTON. Reprinted from the Annals of the Astronomical Observatory of Harvard College, Vol. XLII., Part I. Cambridge, 1897. 4to. Pp. 43–128. Pls. VII.

Ten years ago no one would have thought that a serious piece of scientific work could have for its subject the exploration of the air by means of kites. Yet, as has been frequently pointed out in this JOURNAL during the last two years, the records obtained from the free air, at altitudes up to two miles above the earth's surface, by means of meteorological instruments attached to kite lines, have given extremely valuable results. So much so, indeed, has this been the case that *kite meteorology*, if we may so term it, has come to be recognized as an increasingly important branch of the general science of meteorology. Occasional reference has been made in these columns to the kite work done at Blue Hill Observatory, under the direction of Mr. A. Lawrence Rotch, by Messrs. Clayton, Fergusson and Sweetland. This work is now well known, but until the present time there has been no complete report upon it.

The publication, in the Annals of the Harvard College Observatory, of a monograph on *The Exploration of the Air by Means of Kites*, marks an epoch in the history of modern meteorology. The Weather Bureau issued, in 1896, a valuable Bulletin (by Professor Marvin) entitled *Kite Experiments at the Weather Bureau*, but this was concerned chiefly with the construction of kites and the forces acting on them, and did not include a discussion of the instrumental records obtained by means of the kites.

It is impossible, in a brief notice, to do the Blue Hill kite report justice. There are three chapters in all. The first, on *Kites and Instruments*, is by Mr. S. P. Fergusson, and deals with

the details of construction of the kites and of the meteorographs. The second chapter concerns the *Results from the Kite Meteorographs and Simultaneous Records at the Ground*, and includes complete tables containing data as to the altitudes of the kites; the temperature of the air at the kite, on Blue Hill and in the valley at the base; humidity and wind velocity at the kite and on the hill, etc. The third chapter is by Mr. Clayton and is a discussion of the records. If anyone has had any doubts as to the scientific quality and as to the value of the kite work done at Blue Hill, a glance at this chapter will amply suffice to dispel his doubts. A laborious collection of data and a careful study of these data have clearly preceded the final writing of this discussion.

It would detain us too long were we to call attention to the many noteworthy points which Mr. Clayton has brought out. Only a few can be mentioned. The anemometer records show that between the average heights of 100 and 400 meters the rate of increase of velocity for each 100 meters of greater altitude is 0.6 mile per hour, this being a slower increase than has been found to obtain in the cloud levels higher up above the top of Blue Hill. The change in direction of the currents aloft, shown by the shifting of the kites during their ascents, is interesting. The prevailing tendency is for the kites to indicate currents from the west aloft, no matter with what surface direction of wind they left the ground. The temperature results are naturally the most important. It appears that the diurnal range of temperature diminishes rapidly with increasing altitude in the free air, and almost disappears, on the average, at 1,000 meters.

The variations in change of temperature with altitude are classified into six types, all of which are striking. To mention only three, type 4, which Mr. Clayton calls the *warm wave* type, is produced when a warmer current overflows colder air, and in a majority of cases, when found below 2,000 meters, is caused by the approach of a warm wave, which, moving faster in its upper strata than in the lower, overflows the colder air aloft before it is itself felt as a warm wave on the earth's surface. Such a type, when its existence is known, makes possible the forecast of a warm wave with a high degree of certainty. The *cold wave* type (type 5) shows a fall of temperature with increase of altitude at the adiabatic rate of unsaturated air, above 300 metres, while the night curve shows a rapid decrease of temperature with increase of altitude from the ground upward, these conditions making it possible for showers to occur if the lower air is damp enough. The connection of tornadoes and thunderstorms with falls in temperature is well known, and these results throw much light on the vertical temperature gradients at times of such disturbances. The sixth type is, perhaps, the most interesting of all. It shows the same or nearly the same temperature from 400 to 1,400 metres or more, and is found prevailingly in anticyclones. This is of special importance because of its bearing on the Hann, or driven, theory of anticyclones; for if, as generally stated, the warm and dry air at considerable altitudes in anticyclones is the result of warming by descent and compression, the vertical temperature gradient in anticyclones should be at the adiabatic rate, or nearly at that rate. No adequate explanation of these apparent contradictions appears as yet, and further temperature data from the free air in anticyclones will be awaited with interest.

The above are only a few of the many noteworthy points which are brought out in this valuable monograph. Meteorologists are under a debt of gratitude to Mr. Rotch for his liberality in conducting the experiments, and to Mr. Clayton for the masterly way in which he has dealt with the data under discussion.

R. DeC. Ward.

Harvard University.

Outlines of Descriptive Psychology. By George Trumbull Ladd. New York, Charles Scribner's Sons. 1898. Pp. xi+428.

The present volume covers substantially the same field as the author's 'Psychology, Descriptive and Explanatory,' but is intended rather as a text-book than as a treatise for advanced students. It is not a mere abridgment of the former; every point has been reviewed and the expression revised, so that few sentences read exactly alike in the two works.

The arrangement of chapters and the development of the subject is practically the same in both, as might be expected, in view of their common authorship. But further than this, whole phrases and sentences are to be found everywhere which furnish parallel readings with but slight verbal alterations. A frank acknowledgment of this parallelism, though not a matter of primary importance, might have been of considerable assistance to some readers. On the whole, the verbal changes referred to are in the interest of conciseness and smoothness of diction, and the limiting of discussion in the 'Outline' to a few salient points makes the presentation clearer and more acceptable to the ordinary student. Assuming the general identity of standpoint of the two works, we need do no more than point out their most striking differences. In the earlier work the chapter on Impulse, Instinct and Desire is placed after the treatment of perception, reasoning and the emotions, and just before the will. In the 'Outline' it is advanced to the first place in the part devoted to the Development of Mental Life, so that it precedes even the discussion of Perception. This is a notable indication of the larger prominence which the 'motor consciousness' is obtaining in psychology.

A chapter is added in the 'Outline' on the relation between mind and body. The author eliminates the metaphysical side of the topic, which he has discussed in his Philosophy of Mind, while the treatment of the scientific aspect may be considered an advance on the position taken in his two works on physiological psychology.

The genetic standpoint is emphasized more than in any of Professor Ladd's previous works, while laboratory psychology is given more space and greater importance, relatively, than in the larger descriptive psychology. Diagrams occur frequently to illustrate both particular experiments and curves of general results. In connection with the latter, it should be noted that the diagrams on pages 84 and 85, which are given for the purpose of exhibiting the difference between Weber's and Fechner's statements of the psycho-physical law, are rather misleading; the axes of sensation and stimulus are reversed in the two drawings, making the curves difficult of comparison, and, moreover, the interpretation of the horizontal distances (sensation increments) in the first diagram is somewhat open to question. The psycho-physical law itself is stated (in italics) as follows: "For any given class of sensation the least noticeable difference is a constant fraction of the sensation" (p. 83). A slip of this character is unusual in so careful a writer as Professor Ladd.

It is scarcely in place here either to approve or to criticise Professor Ladd's general positions, which are too well known to call for any special review. The distinction between processes and development of mental life forms the basis for a two-fold division of the work. The author reminds us in his preface that experiment has been most frequently and successfully applied to the elementary phases of mental life, and that it has accomplished but little in the higher types of psychical process. The same position is maintained in the body of the work, where references to experimental results are largely confined to the first part.

As indicated by the title, the 'Outline' is a 'descriptive' treatment of psychology. The omission of detailed 'explanatory' portions, which appear in the larger work, make it available for general class-room work, and in this sphere it will doubtless prove of extreme value. Page references to well-known authorities are given at the end of each chapter, supplying a more detailed treatment for those who wish it.

H. C. WARREN.

SCIENTIFIC JOURNALS.

American Chemical Journal, April. 'An Investigation of some Derivatives of Orthosulphobenzoic Anhydride:' By M. D. SOHON. The author studied the action of alcohol, phenols, ammonia and amines on the anhydride and obtained esters, phthaleins and other derivatives which were well characterized. A series of sulphonic acids isomeric with the sulphaminebenzoic acids was obtained. 'Iodometric Estimation of Tellurium:' By J. F. NORRIS and H. FAY. The authors oxidize the tellurous acid with potassium permanganate, estimate the excess of the latter with potassium iodine and sul-

phuric acid and determine the iodine set free by sodium thiosulphate. 'The Relation of Trivalent to Pentavalent Nitrogen:' By A. Lachman. Preliminary study of the reactions of nitrosamines. 'On Paramethoxyorthosulphobenzoic Acid and some of its Derivatives:' By P. R. Moale. 'Decomposition of Paradiazoorthotoluenesulphonic Acid with Absolute Methyl Alcohol in the presence of certain substances:' By P. R. Moale. The decomposition was studied in the presence of sodium methylate, ethylate, potassium hydrate, ammonia and aniline. 'Parabenzoyldiphenylsulphone and related compounds:' By L. C. Newell. 'The Action of Ethylic Oxalate on Camphor:' By J. B. Tingle.

J. Elliott Gilpin.

SOCIETIES AND ACADEMIES.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 77th meeting, held in Washington, D. C., on April 13, 1898, Mr. J. A. Taff, U. S. Geological Survey, discussed the 'Geology of the McAlister quadrangle.' This quadrangle covers a quarter degree in northwestern Choctaw Nation, Indian Territory. Its geology is practically a duplication of the western Arkansas coal field and older Carboniferous rocks. The coal-bearing rocks, shale, sandstone and coal occupy the northwestern half of the quadrangle and are nearly 6,500 feet thick. Two productive coal beds have been developed. One, the Hartshorn or Grady coal, is at the base, and the other, the McAlister coal, is about 1,350 feet higher in the series. Each is about four feet thick and produces a good strong coal. Sandstone, shale and limestone occur below and south of the coal-bearing rocks and have an aggregate thickness of nearly 1,800 feet. The structure is Appalachian. That of the coal field is canoe-shaped synclines and unsymmetrical anticlines. The rocks south of the coal field are greatly faulted and intensely folded. The faults are overthrust and the folds overturned toward the north. The displacement of the greater faults are estimated to be from 7,000 to 10,000 feet.

Under title, 'The Probable Age of the McAlister Coal Group,' Mr. David White presented a synopsis of the results obtained from a study of the fossil plants of the McAlister, I. T., coal field. The flora of the Grady or Hartshorn coal he finds to indicate a reference to the 'Lower Coal-bearing Division' of Winslow, or the basal portion of the Upper Coal Measures of Branner and Smith, in Arkansas, and a stage near the base in the Allegheny Series of the Ohio-Pennsylvania bituminous regions. The plants of the McAlister coal, about fifteen hundred feet above the Grady coal, assure a correlation with the 'Upper Coal-bearing Division' of Winslow, in Arkansas, a stage, perhaps near the Lane Shales, in the lower half of the Missourian, in Arkansas, probably below the Pittsburg coal in Pennsylvania, or near coals F or G of the Northern Anthracite field. Vegetable remains, collected by Messrs. Taff and Richardson from an horizon about two thousand feet above the McAlister coal, constitute a distinctly Coal Measures flora, without any characteristic Permian species, and bespeak a remarkable expansion of the Upper Coal Measures, or Missourian, in the Indian Territory coal field, such as is perhaps comparable to the great dialation of the Lower Coal Measures in the Central Appalachian region.

The last paper was by Mr. H. W. Turner on 'The Succession of the Igneous Rocks of the Sierra Nevada.'

In Jura-trias time in the northern Sierra Nevada volcanoes poured forth acid lavas, meta-rhyolites and meta-dacites. These acid lavas were followed by more basic lavas, meta-augite-andesites (augite-porphyrites). The succession is here clearly: first, acid; second, intermediate to basic lavas. During nearly all of Cretaceous time, and perhaps also during the Eocene, the volcanic forces of the Sierra Nevada were quiescent. The first Teritary eruptions of large volume of which there are records were rhyolite. After another but shorter period of rest, during which the rhyolitic lavas were partly eroded, the volcanoes emitted vast floods of andesite. This succession does not accord with the theory proposed by Iddings, that the first eruption of a given volcanic center are of intermediate lavas followed by lavas more acid or more basic, or both.

Wm. F. Morsell.

SCIENCE

FRIDAY, MAY 6, 1898.

CONTENTS:

THE NATIONAL ACADEMY OF SCIENCES.

THE annual stated session of the Academy was held in Washington, April 19th to 22d.

The President, Dr. Wolcott Gibbs, presided over all the sessions and thirty-five other members of the Academy were in attendance, as follows:

Messrs. Cleveland Abbe, Alex. Agassiz, Geo. F. Barker, Carl Barus, A. G. Bell, J. S. Billings, W. H. Brewer, W. K. Brooks, Elliott Coues, Wm. H. Dall, Wm. L. Elkin, S. F. Emmons, G. K. Gilbert, Theo. N. Gill, F. A. Gooch, Arnold Hague, Asaph Hall, James Hall, C. S. Hastings, Geo. W. Hill, Alpheus Hyatt, S. P. Langley, O. C. Marsh, T. C. Mendenhall, A. A. Michelson, Simon Newcomb, J. W. Powell, F. W. Putnam, Ira Remsen, H. A. Rowland, C. A. Schott, C. D. Walcott, Wm. H. Welch, C. A. White and A. W. Wright.

The public and business sessions of the Academy were held in the pavilions of the Congressional Library. It was an advantage for members to have a convenient opportunity to examine the magnificent arrangements and decorations of the library, and the place of meeting was preferable to the extemporized quarters in the National Museum. Still the rooms were not very accessible, their acoustical properties were extremely bad, and the temporary character of the arrangements are scarcely befitting a great National Academy. It is curious that Washington, with its immense scientific activity and continuous series of meetings and conventions, should have no suit-

able place for the sessions. In view of the relations of the National Academy to the government, it would seem proper that a building, or at least an auditorium and committee rooms, should be provided for its use. Other societies could then be permitted to occupy them when the Academy was not in session. It is, however, possible that the Washington Academy of Sciences may be able to provide such a building.

The business sessions of the Academy, in accordance with an excellent plan adopted two years ago, were held in the mornings, while the sessions for the reading of scientific papers, to which the public is invited, were in the afternoons. The scientific program was as follows:

I. The Coral Reefs of Fiji, . . A. AGASSIZ.
II. The Fiji Bololo, A. AGASSIZ and W. McM. WOODWORTH.
III. The Acalephs of Fiji, A. AGASSIZ and A. G. MAYER.
IV. The Variation in Virulence of the Colon Bacillus, ... J. S. BILLINGS.
V. Biographical Memoir of Edward D Cope. THEO. GILL.
VI. New Classification of Nautiloidea, ALPHEUS HYATT.
VII. A New Spectroscope, A. A. MICHELSON.
VIII. On the Hydrolysis of Acid Amides, IRA REMSEN and E. E. REID.
IX. The Question of the Existence of Active Oxygen, IRA REMSEN and W. A. JONES.
X. On the Product formed by the Action of Benzenesul-phonchloride on Urea, IRA REMSEN and J. W. LAWSON.
XI. On Double Halides containing Organic Bases, ... IRA REMSEN.
XII. McCrady's Gymnophthalmata of Charleston Harbor, ... W. K. BROOKS.
XIII. Ballistic Galvanometry with a Countertwisted Torsion System, CARL BARUS.
XIV. A Consideration of the Conditions governing Apparatus for Astronomical Photography, CHARLES S. HASTINGS.
XV. The Use of Graphic Methods in Questions of disputed Authorship, with an Application to the Shakespeare-Bacon Controversy, . . T. C. MENDENHALL.
XVI. A Method for Obtaining a Photographic Record of Absorption Spectra, A. W. WRIGHT.
XVII. Theories of Latitude Variation, H. Y. BENEDICT. Presented by A. HALL.
XVIII. Progress in the New Theory of the Moon's Motion, ... E. W. BROWN. Introduced by S. NEWCOMB.
XIX. On the Variation of Latitude and the Aberration-Constant, CHARLES L. DOOLITTLE. Introduced by S. C. CHANDLER.
XX. A Curious Inversion in the Wave Mechanism of the Electromagnetic Theory of Light, ... CARL BARUS.

Many of the papers were technical in character, and the authors did not attempt to read them in full, but only gave a general outline of the results. Several of the papers were, however, of general interest. Professor Agassiz described in some detail the important results of his recent visit to the islands and coral reefs of the Fiji group. He took with him in the 'Taralla' boring apparatus, but became convinced that the borings made by Professor Sollas and by Professor David on the Atoll of Funafuti do not corroborate the theory of Dana and Darwin—that the atolls and barrier reefs have been formed by the subsidence and disappearance of the central island—but that the great thickness of the coral was merely the base of an ancient reef. Professor Agassiz found, to his surprise, that the Fiji islands are not in an area of subsidence, but, on the contrary, in an area of elevation, reefs being found far above the level of the sea, the elevation amounting to upwards of 800 feet. It was argued that the atolls and reefs can be satisfactorily accounted for by denudation and erosion, in some cases of extinct volcanic craters. In a second paper Professor Agassiz described the sudden appearance of the annelid 'Bololo' at Levuka. It arrives on a certain day in such numbers that the surface of the water resembles thick

vermicelli soup. The eggs and spermatozoa are discharged and nothing is left but empty skins scarcely visible.

Professor Michelson described his important invention of a spectroscope without prisms or gratings made by building up steps of equal thickness of optical glass. With twenty elements 5 mm. thick the resolving power would be 100,000 which is about that of the best gratings. The method is especially important for the examination of single lines and the study of the effects of broadening, shifting or doubling of lines. Dr. Gill read a biographical memoir of Edward D. Cope, based on his address as President of the American Association, which has been published in this JOURNAL. President Mendenhall gave the results of further researches on the lengths of words used by different authors. He is able to show graphically a characteristic curve for a writer, and thus has found a method by which disputed authorship may be tested.

Dr. J. S. Billings resigned the office of Treasurer on account of his removal from Washington, and Mr. Charles D. Walcott was elected in his place. Messrs. Billings, Bowditch, Brush, Hague, Marsh and Newcomb were re-elected additional members of the Council for another year.

No new members of the Academy were elected this year. This appears to be unfortunate, as only thirteen elections have been made during the past eight years, whereas the Academy has lost twenty-eight members by death. The Academy can, by its constitution, only elect five members annually, and as the deaths are likely to amount to nearly this number it is difficult to see how the membership can be maintained if, in certain years, no members are elected, as was the case in 1891, 1893, 1894 and this year.

A large addition was, however, made to the foreign associates of the Academy, whose number is limited to fifty, as follows:

Professor Henri Poincaré, Paris; Dr. David Gill, Cape Town; Lord Rayleigh, London; Professor Adolf von Baeyer, Munich; Lord Lister, London; Professor Edward Suess, Vienna; Professor H. de Lacaze-Duthiers, Paris; Professor Edward Strasburger, Bonn; Professor Felix Klein, Göttingen; Professor Henri Moissan, Paris; Professor Karl Alfred von Zittel, Munich.

The autumn meeting of the Academy will be held at New Haven, beginning on November 15th.

SOME AIDS TO THE STUDY OF STEREOSCOPIC VISION.

THE familiar form which the stereoscope has assumed since Brewster, together with the marked development of photography, has brought about a general appreciation of the striking and frequently beautiful effect which this instrument produces. This form of the apparatus, however convenient, is not best suited to the exposition of the underlying principles of the stereoscopic illusion. These principles involve the general problem of the perception of depth or solidity, and this, in turn, is a rather complicated matter, which involves many details. An important service which the stereoscope performs for the psychologist is the aid which it renders him in the analysis of these factors. Some of the more or less recent variations in the form and construction of stereoscopic instruments furnish added facilities for the demonstration of the factors which enter into the perception of depth. To furnish a brief account of these various aids to the study of stereoscopic vision is the purpose of this article.

One of the most frequently discussed points is the dependence of the appearance of solidity upon the dissimilarity of the two stereoscopic pictures, which, in turn, imitate the differences of the retinal images in the two eyes. The truth of this view can be established be-

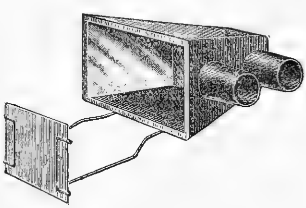
yond any reasonable doubt, and is proved by the fact that all instruments which really produce this appearance of depth, however much they may differ in other respects, must furnish some systematic differences in the two pictures to be viewed. It is evident, however, that this aid to the perception of depth will differ considerably according as the object represented is near or far away. For near objects the differences in the retinal images will be quite marked, while for distant ones the images will be more nearly alike. To magnify the perception of depth in distant views Helmholtz devised the telestereoscope, which acts by practically spreading the distances between the eyes, and which, in combination with lenses, finds a useful application in stereoscopic field glasses. The processes of convergence and accommodation accompany these differences in the retinal images; and these, too, are more active in the perception of near objects than of distant ones. In order to determine which of the two factors, convergence or difference in the retinal images, is the more essential it is necessary to produce one more or less independently of the other. This can be done, first, by viewing in the ordinary stereoscope two views which are precisely alike and which are superimposed by means of convergence; and, again, two views which differ as the two retinal images differ and which are combined with a minimum of convergence by means of devices described further on. The result is unmistakable and shows that convergence is only an added element and that the difference in the retinal images is the all-important factor.

But apart from these factors, which may be expressed in physiological terms—that is, in terms of what goes on on the retina and within the eye and eye-muscles—there are psychological factors in the perception of depth which materially influence the result. While the former are either simple sensations or the inferences from them, the latter involve more complicated forms of interpretation on the basis of perceptions which are the result of a varied experience. First among these is the distribution of light and shade. This factor is so important in most of our experience in the interpretation of depth that it alone frequently determines the visual result and overrules the influence of all other factors. For example, it is not difficult to illuminate an intaglio in such a way that it can be mistaken for a cameo. In the illusion of depth which the artist produces this factor is obviously of supreme importance. A second psychological factor, likewise invaluable to the artist, arises from our constant tendency to interpret outlines and contours as the representations of three-dimensional objects. As a result of our general experience, we are quite prepared to interpret all lines in a painting or an etching or a photograph as representing certain views of objects. We know, of course, that the pictures are flat, but we see them as solid. Especially when this tendency is combined with the interpretation of lights and shadows do we have an appearance of depth which, when skillfully portrayed, seems hardly less real than the reality. A third factor equally operative in pictures and in reality is that summed up in the term perspective, which involves in the main the diminution in the apparent size of the object as its distance from the eye increases. Figures in the foreground and in the background are interpreted not according to their real size—that is, not the number of millimetres that they occupy on the retina, or of inches on the canvas—but according to these as modified by the estimated distance between the object and the point of view of the beholder. The familiarity of objects is, of course, a great aid in the proper estimation of such distances. If two men are represented upon a picture, and the one representation

is one inch in height and the other two inches, we infer (under proper conditions of perspective) not that the one man is twice as tall as the other, but that the two are of approximately similar size, and that the one is considerably more distant. As a further factor one may mention the interrupted view of a more distant object by reason of a nearer object standing in front of it. Most objects are opaque, and on this account we infer the continuity of outlines which are more or less hidden by the objects in the foreground. If, for example, we see in reality or on a picture a bush in front of a fence we do not infer that the fence is broken where the bush prevents us from seeing it, but that it is continuous and farther away than the bush.

When all these factors coöperate they produce a very complete illusion of depth, and frequently one which does not seem to require the operation of the more physiological factors of convergence and the difference in the retinal images. In the case of photographs viewed through the stereoscope we have the combination of all the above factors, and it requires a rather detailed analysis to make clear the influence of each. It is possible, however, to prove conclusively that the difference in the retinal images is the prime factor and that all the others form accessory methods for the inference of depth, but are not at all necessary for this effect. For this purpose we must have stereoscopic views which show no light and shade, no perspective, no interposition of objects. Geometrical figures theoretically constructed have been generally used for this purpose. A very superior series of diagrams has recently been published and forms an important aid to the study of stereoscopic vision. They are the result of the application of the stereoscope to the demonstration of mathematical problems, a result which has been most ingeniously reached by Professor C. S. Slichter,* of the University of Wisconsin. These diagrams represent the motion of a point in space under the influence of three forces acting respectively in the three dimensions of space. A small electric lamp suspended in a dark room is given a pendular motion, and at the same time a stereoscopic camera is itself swung in a direction at right angles to the motion of the lamp. These movements are brought into unison by means of electro-magnets, and the result is that the point of light leaves its trace on the pair of photographic plates precisely as though a pair of eyes were following the movement of the point in and out through the three dimensions of space, but that in addition the track of this point of light is retained from beginning to end. These views thus represent beautiful and intricate mathematical curves and in the stereoscope appear distinctly three-dimensional as wire forms or models. I know of nothing which equals these views in clearness and precision, and I cordially recommend them as test diagrams in stereoscopic experiments. It may be said that any instrument which succeeds in producing from a pair of such views a full and complete appearance of depth is a true stereoscope, and one which fails to do this is not a true and perfect stereoscope.

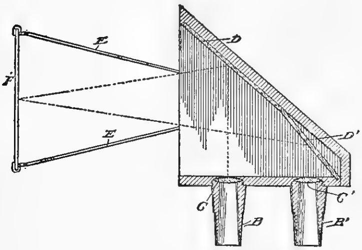
An interesting and novel type of apparatus has recently been introduced under the term of Perspectoscope. It consists in



THE PERSPECTOSCOPE.

*Transactions of the Wisconsin Academy, 1898, Vol. XI., p. 449.

the main of two eye-pieces fitted with suitable lenses and of a pair of mirrors, the two mirrors being set at such an angle that the image from a single picture which is placed at right angles to the eye pieces will be reflected into each of the eyes. The accompanying illustrations will readily make clear the principle. The



PRINCIPLE OF THE PERSPECTOSCOPE.

B. B.'—Viewing tubes. C. C.'—Lenses. D. D.'—Reflectors. E. E.—Picture Holder. F.—Picture.

inventor of this instrument claims that it disproves the accepted theory of the stereoscope, because with it one can see a single picture, such as any ordinary photograph or drawing, in apparent perspective. He further claims that in this way a true perspective is obtained, while the ordinary stereoscope is alleged to exaggerate the perspective.* These claims can be readily disproved; in the first place, the perspectoscope utterly fails to exhibit the test diagrams above described as solid; secondly, the ordinary stereoscope does not as a rule exaggerate the perspective, although such an exaggeration may be readily obtained if desired. In Professor Slichter's diagrams the motion from left to right was in reality equal in extent to the motion forward and backward. I asked a number of persons as they viewed these diagrams to estimate the breadth in terms of the depth, and the general tendency was to regard the diagram as somewhat broader than deep. Although the claims made for the perspectoscope cannot be allowed, it is true that when a photograph is viewed by the average observer in the perspectoscope there is a striking appearance of depth, quite enough to make this apparatus a popular instrument for viewing pictures. How is this effect of apparent depth produced? The answer is in the main that the accessory factors in the perception of depth are here introduced at their maximum efficiency; and added to this there is the action of the lenses in magnifying the objects, and the convenience and precision with which the views as reflected from the two mirrors may be superimposed. It is a well-known fact that a large magnifying glass is itself an important aid in the perception of the third dimension in a photograph, and this aid is utilized in the perspectoscope in a more convenient form. For the same reason the glasses in the ordinary stereoscope are not prisms but prismatic lenses.

To one who is familiar with the appearance in the stereoscope of a pair of stereoscopic views (or stereographs, as Le Conte Stevens suggests) there is something decidedly lacking in the perspectoscope effect; and yet, unless the two are viewed immediately in succession, the average observer might well be misled to regard the perspectoscope as really producing the appearance of depth. This is altogether likely to be the case if the observer happens to use stereographs which are not well made. Unfortunately, a very large proportion of the views commonly sold are far from perfect, and a considerable part of a dealer's entire stock which I recently examined was made up of views which were not stereo-

* He also argues that the perspectoscope obviates the necessity of extreme convergence as the eyes assume a natural position. This is true, but the objection holds against the Brewster stereoscope, not against all others. Further, this advantage is here gained at the expense of inverting the picture from right to left. He makes other inadmissible statements, which it is not necessary to consider here.

scopic at all, the two impressions of the photograph being *precisely alike.* It would, of course, be true that there would be no difference between a pair of such pictures viewed in the stereoscope and a single one of them viewed in the perspectoscope. The difference in this effect can readily be produced by any one who can procure two copies of the same pair of true stereoscopic pictures. Cut these in half and set up first either the two right or the two left halves, and then contrast this appearance with that obtained by viewing a right and left half. In this way the observer will soon train himself to recognize the difference between a genuine stereoscopic effect and one that only approximates it to a greater or a less extent. In the one case the object stands out with all the reality of life, while in the other case there is a relative flatness and only a pictorial type of perspective. It is something like the difference between viewing a model or a tableau and a picture; in the one case we have the difference in the two retinal images, together, of course, with all the accessory aids to the perception of depth, while in the latter case we have all the accessories but not the main factor. This experiment thus serves as an *experimentum crucis* and further indicates that it requires some little experience with stereoscopic effects to enable one to judge between the true appearance and those which more or less successfully imitate them.

It is quite an easy matter, however, to make a true stereoscope out of the perspectoscope; one need only make the reflecting mirrors adjustable and set them so that the one will reflect into the one eye one-half of an ordinary stereograph and the other mirror will reflect into the other eye the other half. Or the same result may be produced by a pair of fixed mirrors set at a suitable angle to so direct the reflected images for the stereograph of ordinary size. This form of construction for a simple and effective stereoscope has not, to my knowledge, been described.

The attempt to obtain a stereoscopic effect from a single picture has been frequently made, but in so far as it is successful it depends upon securing two dissimilar views of some picture which shall more or less closely imitate the differences between the two views of a stereograph. Le Conte Stevens* has clearly indicated that by the combination of a pair of perfectly similar conjugate pictures held inclined, like the two pages of a partly opened book, one may obtain a stereoscopic effect. In the same way photographs may be prepared from a single picture in which the picture is placed at an angle with the plane of the plate; and by suitable shifting of the angle one may secure two photographs of the original single photograph which will present differences similar to those in the two halves of a stereograph. This difference may be described by saying that in the right-hand view the left portion is somewhat crowded together and the right portion somewhat expanded, while the reverse is true of the left-hand picture. A pair of views, thus prepared, when placed in a stereoscope, give an approximate *stereoscopic effect.* In *Nature* (Feb. 3, 1898) Sir David Salomons describes an arrangement of lenses which will bring about such a distortion and will thus produce from a single picture the effects of depth. The device consists of a pair of wedge-shaped plano-cylindrical lenses, which, with their thicker edges set together, are fixed in position near the two prismatic lenses of an ordinary stereoscope and between them and the picture. A per-

* In the *Philosophical Magazine*, May, 1882. In the same place is described a reversible stereoscope which is much better suited to experimental purposes than the ordinary stereoscope, and merits a more general introduction in psychological laboratories than it has as yet secured.

sonal note adds the information that a thick cylindrical lens was used about $1\frac{3}{4}$ by $1\frac{1}{4}$ inches, with the concave surface a section of a circle, 6 inches in radius; that these lenses were fixed about one inch away from the stereoscopic lenses and about 3 inches from the picture.

I have prepared a pair of pseudo-stereographs from the one-half of a true stereograph, and could thus directly compare the life-likeness in the two cases. The advantage is entirely on the side of the true stereograph, not only on account of greater technical precision in the photographic plates, but because the degree and distribution of the dissimilarities of an actual view photographed by a stereoscopic camera more clearly imitate the retinal dissimilarities than do the two views of a photograph held at opposite angles with the camera. When I compare the result in the pseudo-stereographs with that of an arrangement like that described by Sir David Salomons (which, however, I have reproduced in general, not in precise detail) I regard the former as giving the better result. All these processes, however, are limited in scope and demonstrate that it is possible to produce a stereoscopic effect in a single picture only in so far as such a picture may be made to yield a pair of appropriately dissimilar views.

In this connection may be mentioned a device published in the set of Pseudoptics of Professor Münsterberg. It consists of a card suitably shaped to be held against the forehead and the ridge of the nose, so that the diagrams printed on the two sides of the card may be seen at close range, the one by the left eye, the other by the right, and then combined by projection outward upon a common imaginary plane. To allow for the fore-shortening of lines at this close range as compared with their projection, the vertical lines of the diagram are exaggerated in thickness as compared with the horizontal lines, and the nearer lines are proportionately heavier than the farther. This device presents a stereoscope in its utmost simplicity; but still it includes the combination of a pair of appropriately dissimilar views, and provides that each eye shall see only its own view. In the same connection may be mentioned another very simple device which is very useful for demonstration, but has not been generally described.* It may also be found in the set of Pseudoptics and consists of a pair of tubes about $1\frac{1}{4}$ inches in diameter and $8\frac{1}{2}$ inches long, over the ends of which are placed caps which contain on transparent paper the pair of stereoscopic diagrams. The tubes are simply held one before each eye and are rotated until the two diagrams are superimposed, when a stereoscopic combination takes place by simple convergence. This device is again limited in scope, for the diagrams must be small and not too elaborate.

Some years ago, in verifying the possibility, or rather the impossibility, of producing a true stereoscopic effect with a single picture, I attempted to utilize the principle of the telestereoscope. This principle consists in the reflection of images first from a pair of mirrors which meet at the point between the eyes and there form an angle of about 80°, and then again from a pair of mirrors farther away to the right and left and parallel to the first set. The ordinary stereograph is then viewed by reflection from the mirrors. In this stereoscope the path of the rays is long and the picture appears diminished in size. I have recently constructed such an apparatus with the two outward mirrors set on a pivot, with which I can view either single pictures or a pair of stereoscopic ones. This apparatus is, therefore, both a stereoscope and a perspectoscope, if by the latter

*It is described in the 'American Text-book of Physiology' (1897), p. 802.

term we mean an apparatus which in one way or another imitates a true perspective. As it lacks lenses (although these could be supplied), it does not yield such striking results as other stereoscopes, but is useful in illustrating clearly the difference between a combination of a pair of different views, for the change can be made from one to the other very quickly and without involving any other modification. I am not aware that the utilization of a telescope for this purpose has been previously described.*

In Hermann's 'Handbuch der Physiologie' (3, p. 587) may be found a description of a device, originating with Hirschberger, by which the picture is viewed near by with the eyes in nearly a parallel position, and thus an approximate stereo effect is produced with a single picture. This was accomplished by means of a pair of prisms; but as the arrangement is practically an inverted telestereoscope (with the outermost pair of mirrors adjustable and spread to the distance of the space between the eyes), I have used such an inverted telestereoscope for this purpose and with very good success. The effect of depth is much better than in the perspectoscope, especially when a pair of lenses is used with this device, but it is not as effective as in a double-picture stereoscope. Geometric diagrams seem distinctly projected in space, and photographic representations are almost as clear as in an ordinary stereoscope. In other words, there are all degrees of the stereoscopic illusion from flatness to perfect solidity, and this device represents about the maximum degree obtainable with a single picture.

Another rather recent contribution is the combination of the stereoscope with the kinetoscope, thus producing the illusion of figures moving in three dimensions of space. Professor Münsterberg described such a device* in which the effect was obtained by viewing through a pair of series of slits of a large disc a single series of stroboscopic figures; the pair of series of slits is so arranged that one eye looks through the one, and the other eye through the other, and as the slitted disc and also the one with the figures rotate rapidly the two eyes obtain slightly different views of the stroboscopic figures; but the images follow one another so rapidly as to fuse and produce the illusion of motion and of depth. In a recent letter Professor Münsterberg informs me that the same effect may be produced by the use of a disc with one slit for both eyes and a mirror held a few inches behind the disc; for every slit there correspond two pictures drawn on the back of the disc, which when seen in the mirror furnish the appropriate pair of stereoscopic views. He also suggests that the same may be done by spinning such a disc upon a mirror with appropriate illumination. Dr. Sanford has also constructed a device for obtaining a stereo-stroboscopic effect.

The problem of projection by the lantern of stereoscopic pictures is receiving renewed consideration. The two methods most in vogue are those of the double lantern with the one view seen through green and the other through red light, and the other by application of polarized light. It is prob-

* I have amongst my stereoscopes one in which the lenses are prismatic in one-half only, the other half being portions of true double convex spheres. By the rotation of each lens to a definite position we can use the apparatus simply as a pair of lenses and thus view a single picture at the proper focus. The instrument is called a stereo-graphoscope. In the latter form it is intended to accomplish just what the perspectoscope accomplishes, but it is not so convenient. The apparatus is very convenient as a stereoscope, because it admits of some adjustment of the positions of the two halves of the stereograph.

* See *Psychological Review*, 1894, I., p. 56. Also Scripture, 'The New Psychology,' pp. 431–435, where this and similar devices by Sanford (*American Journal of Psychology*, 1894, p. 576) and Dvorak are also described.

able, however, that these processes will be further simplified before they will meet with general introduction. I am informed that several devices are being considered which will enable the effect to be produced by means of a single lantern. Various principles involved in the forms of stereoscope above discussed make it evident that such a device is by no means impracticable.

This eclectic summary of the progress of invention in the field of stereoscopic vision would seem to indicate that the interest in this topic is undiminished and that the field is still open for improvements and modifications which shall be useful in exhibiting the principles which underlie the workings of this truly psychological instrument.

Joseph Jastrow.
University of Wisconsin.

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*CLASSIFICATION OF IGNEOUS ROCKS.**

Professor Merrill remarked at the last meeting of the Geological Society that rock species do not exist in the definite sense in which this term is used in the organic world. Probably no petrographer will deny this conclusion.

Admitting, then, that rocks are mineral mixtures which may vary indefinitely, it is clear that the naming of these mixtures may be carried to excess. Let us, for example, take the feldspathic lavas. These may be divided into three great groups, the alkali-feldspar lavas or trachytes, the oligoclase-andesine lavas or andesites, and the labradorite-anorthite lavas or basalts. These three groups may be written graphically as follows:

The demands of modern petrography, perhaps, require the recognition of intermediate groups which may be designated by compound names. Thus a rock intermediate between syenite and diorite may be called a syenite-diorite. Such would be the rocks called mozonite by Brögger. Between the three great groups of feldspathic lavas above outlined there may be instituted three intermediate groups, as represented in the above diagram. One group intermediate between trachytes and andesites may be called the trachyte-andesite group; that intermediate between the andesites and basalts the andesite-basalt group, and that intermediate between trachytes and basalts the trachyte-basalt group, or, as Washington has suggested, trachydolerite, adopting a term in use in Italy. The recognition of such intermediate groups seems to me quite desirable, but if the subdivisions are carried still further the results are, perhaps, of questionable value. To see how complicated the classification may easily become, let us take the single intermediate group of trachyte-basalts. There are in Italy, in the Yellowstone Park, near Buda-Pesth and in California rocks which occupy this intermediate position. These lavas have been studied by skilled petrographers, and their excellent descriptions, with the accompanying chemical analyses, leave no doubt as to their exact nature.

The following names have been proposed for different varieties:

Trachyte-basalt group:

Yellowstone Park (Iddings)	Absarokite Shoshonite Banakite
Italy (Washington)	Trachydolerite Toscanite Vulsinite Ciminite
Buda-Pesth (Koch)	Labradorite-trachyte
California (Ransome)	Trachandesite (Latite).

Dr. Washington, in one of his admirable petrographic papers,* notes the close resemblance of his Italian lavas with those of the Yellowstone Park, but nevertheless

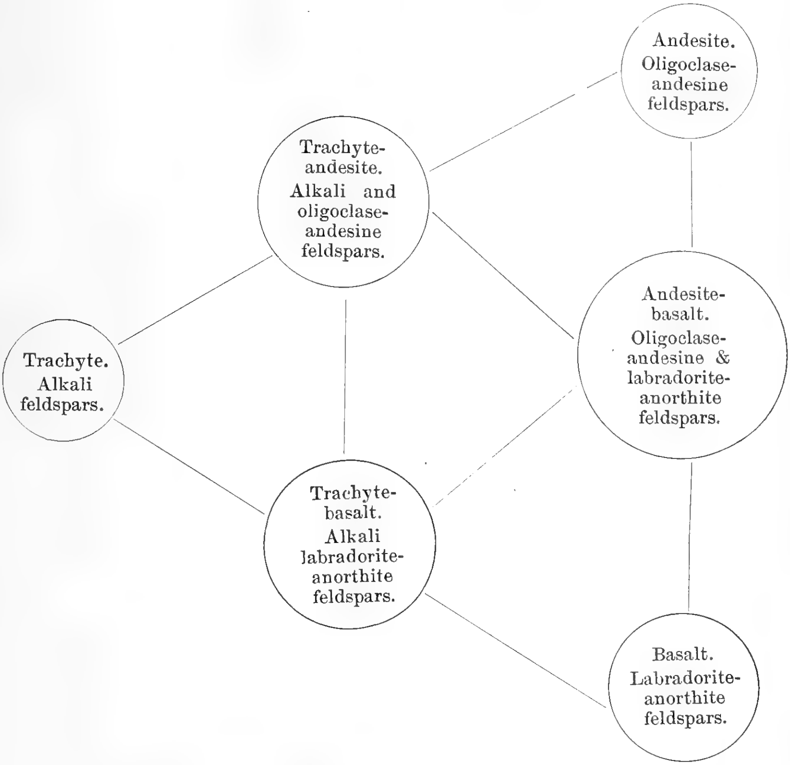
* Read before the Geological Society of Washington on February 9, 1898.

* *Journal of Geology*, Vol. V., page 363, 1897. See also table on page 366.

does not consider it advisable to apply the same names to the rocks of the two localities on account of minute differences and overlaps in chemical and mineral composition.

as no doubt this hypothetical third set of lavas would likewise overlap the flows in Yellowstone Park and in Italy.

Two of the names used in the above table, namely, trachydolerite and labradorite-



It is safe to assert that if a petrographer were given some specimens of similar intermediate lavas from an entirely new field to name he would find difficulty in choosing between the names adopted for the Yellowstone Park lavas and the names adopted for the Italian lavas, and the tendency would be to adopt still a third set of names,

trachyte, give at once to the reader a definite idea of the composition of the rocks. The term trachandesite* used by Dr. Ran-

*Since writing this Dr. Ransome has changed his name to a more specific name, *latite*. But as he regards his rocks as intermediate between trachyte and andesite the statements here made regarding them still apply.

some would be at variance with the set of intermediate families proposed in the above diagram. However, I understand Dr. Ransome to regard the feldspathic lavas as being more properly represented in a linear series, that is to say, the andesites would be regarded as a group intermediate between trachytes and basalts, and, following this system, it would be impracticable to institute any such group as the trachyte-basalts. The only possible intermediate group between the trachytes and plagioclase lavas would be trachyte-andesites. Dr. Ransome, in a forthcoming bulletin of the U. S. Geological Survey* on the trachandesites (latites), clearly states their relation to the Italian and Yellowstone Park lavas, and the position of these California rocks is at once evident to the reader. However, if we call all lavas composed of labradorite-anorthite feldspars, basalts, the recognition of a group intermediate between the trachytes and basalts seems inevitable.

While greater definiteness is unquestionably desirable in the naming of rocks, it seems but fair to the general geologist, and even to many who have given some time to the study of igneous rocks, that general terms should be used in all such descriptions, even if in subordinate paragraphs the rocks are given more definite names. This enables the reader at once to place approximately the rock.

It is possible that many of the current names for rocks could be improved by substituting a name derived from the most prominent mineral which enters into their composition. Thus a syenite might be called an orthosite, from the French term orthose or orthoclase. An augite-syenite would then be called an augite-orthosite. Even a granite might be called a quartz-orthosite, if in the use of compound terms we recognize only those minerals which are essential constituents and never use the names of accessory minerals in this way. There appears to be the greatest latitude in this matter. Some rocks are called hornblende-andesites in which only occasional hornblende needles are to be noted, and the same statement may be made with variation as to the mineral with a great many names. It appears to the writer that a hornblende-andesite should be a lava composed, if sufficiently crystalline, chiefly of oligoclase and andesine feldspars, with relatively abundant hornblende. This matter of keeping in mind the relative proportions of minerals in naming rocks, if carried out throughout the entire series of rocks, both with granolites and effusive rocks, would result in a name conveying at once a tolerably accurate idea of the composition of the rock.

The term basalt indicates nothing whatsoever to the reader as to what the rock is made up of. If we use the French term labradorite we have at once a definite idea as to what the mineral composition of the rock is. The term labradorite is used by the French for basalts which contain no olivine. The term olivine-labradorite could be used for olivine-basalt.

This method of deriving the name of the rock from its mineral components is thus not at all new. The andesites usually contain the feldspar andesine. The group of peridotites derives its name from the word peridot or olivine. A mica-peridotite is plainly a mica-olivine rock. An enstatite-peridotite rock is plainly an enstatite-olivine rock. There are now two terms used for the latter. One is Harzburgite* and the other Saxonite, and there has been much discussion over which name should take precedence. If we drop both terms we relieve the memory and make it plain to every one what the composition of the rock is.

* An abstract of this bulletin will soon appear in the *Am. Jour. Sci.*

* Rosenbusch, *Mikroskopische Physiographie der Massigen Gesteine*, 1896, p. 355.

It is, of course, evident that such mineralogical names cannot be applied to rocks of complex composition.

It seems clear that the naming of rocks may be carried to excess, and that the science of petrography may readily be buried under its own nomenclature.

H. W. TURNER.
U. S. GEOLOGICAL SURVEY.

THE DIVERSE FLORAS OF THE ROCKY MOUNTAIN REGION.

FEW persons living in the Eastern States are aware of the greatly diversified country which is included under the general title of the Rocky Mountain region. I have often been requested by correspondents to procure species which, being recorded from the 'Rocky Mountains,' were presumed to exist just outside my door, but which, as a matter of fact, were not obtainable within a hundred miles.

The striking diversity which exists, according to altitude, latitude and longitude, is worthy of attention from several points of view. To the horticulturist or botanist it suggests great possibilities of finding even conspicuous new species as new localities are explored. To the horticulturist it also strongly suggests possibilities in the way of fruit-raising, since those localities which have different wild plants are likely to be suitable for different and peculiar varieties of fruits. Valleys now uncultivated may in the future become famous for their special varieties of wine-grapes, of apples, peaches or vegetables. What has been done in Europe may be repeated here in time. Then again, to the geologist the facts are extremely significant. If the present flora of our region could be preserved in the rocks we should have a series of beds absolutely contemporaneous, yet exhibiting almost totally different sets of fossils, not merely as to species, but as to genera. The animal remains would be almost equally diverse; the insects even more so than the plants.

On August 30, 1889, I noted the more conspicuous plants observed in a short walk by Willow Creek, Custer County, Colorado, at about 8,200 feet altitude. The list is given here, and in a parallel column the nearest approximation to it obtainable in the immediate vicinity of my present home, Mesilla, New Mexico, 3,800 feet above sea level.

WILLOW CREEK, COLORADO.	MESILLA, NEW MEXICO.
Aconitum Columbianum.	Clematis ligusticifolia.
Delphinium scopulorum.	Ranunculus Cymbalaria.
Actæa spicata.	
Berberis repens.	(No Berberideæ.)
Erysimum asperum, var.	Sisymbrium, spp.
Viola Canadensis.	(No Viola.)
Silene Scouleri.	(No representative.)
Sidalcea candida.	Sphæralcea angustifolia.
Geranium Richardsoni.	(No representative.)
Lupinus argenteus, var.	Sophora sericea.
Thermopsis montana.	Dalea scoparia (with a forma nov. subrosea, flowers magenta).
Oxytropis Lamberti.	Astragalus Wootoni.
Fragaria vesca.	Prunus sp. (escaped from cultivation).
Potentilla fruticosa.	
Rosa blanda, var.	
Parnassia fimbriata.	(No representative.)
Ribes oxyacanthoides.	
Epilobium angustifolium.	Œnothera Hookeri and Œ. pallida.
Osmorrhiza nuda.	(Nothing near.)
Heracleum lanatum.	
Lonicera involucrata.	(Nothing near.)
Galium boreale.	(Nothing near.)
Aster lævis.	Aster tanacetifolius.
Aster Fremonti.	Aster canescens.
Erigeron glabellus mollis.	Erigeron divergens.
Gymnolomia multiflora.	Verbesina encelioides.
Achillea millefolium.	Lepachys Tagetes.
Rudbeckia laciniata.	Helianthus annuus.
Cnicus Parryi.	Cnicus ochrocentrus, var.
Troximon glaucum.	Pyrrhopappus, sp.
Campanula rotundifolia.	(Nothing near.)
Arctostaphylos uva-ursi.	(No Ericaceæ.)
Pyrola rotundifolia, var.	
Apocynum androsæmifolium.	Apocynum cannabinum (fide E. O. Wooton).
Gilia aggregata, var.	Gilia, sp.
Echinospermum floribundum.	Krynitzkia, sp.
Mimulus luteus.	Maurandia Wislizeni.
Castilleia integra, var.	
Orthocarpus luteus.	
Pedicularis procera.	
Polygynum aviculare.	Polygonum, spp.
Polygonum tenue.	
Polygonum convolvulus.	
Chenopodium album.	Chenopodium leptophyllum.
Comandra pallida.	Comandra pallida.
Quercus Gambelii.	(No Quercus.)
Populus tremuloides.	Populus Fremonti.
Iris Missouriensis.	(Nothing near.)
Smilacina stellata.	Yucca, spp.

Streptopus amplexifolius.	
Veratrum Californicum.	
Phleum pratense (ex. cult.).	
Juniperus communis.	Ephedra.
Picea Engelmanni.	(No Picea.)
Picea pungens.	
Pinus ponderosa scopulorum.	(No Pinus.)
Pteris aquilina.	(No Ferns.)
Equisetum arvense.	Equisetum, sp.
Equisetum hiemale.	
Marchantia polymorpha.	
Puccinia veratri.	Puccinia evadens, P. sphæralceæ.
Usnea barbata.	

I have not given very much study to the flora of Mesilla, because my friend, Professor E. O. Wooton, is working upon it, so it may be that there exist a few better representatives than I have cited. I have, however, examined the flora a good deal in my searches for insects, so it is not probable that much change would be necessary. It will readily be appreciated that if the Colorado species had been found as fossils, and another bed in New Mexico, rich in plant remains, had shown no more resemblance to the first than is here shown, geologists would have been very ready to assign different ages to the beds.

Local lists of plants, as ordinarily published, do not sufficiently bring out the differences between florulæ. In the first place, collectors will often mix up two or three florulæ in one list; in the second, in the effort to make a complete list, they will include plants which are either extremely rare or actual aliens. In these days of railroad travel, it seems common to see near railway lines, and in other places, little colonies of plants out of their proper environment, which persist a while and then perish.

I now propose to show that such differences as above indicated do not only occur between the recognized zones, but within the limits of the same zone.

In Mesilla, New Mexico, on June 18, 1897, I collected weeds in the cultivated ground of the Casad orchard. I give the list; and in a parallel column a list from the sandhills, also in Mesilla, choosing as nearly representative plants as I can. For the determinations of many of the plants I am indebted to Professor E. O. Wooton.

Cultivated Ground, Mesilla.	Sandhills, Mesilla.
Anoda hastata.	Mentzelia multiflora.
Sphæralcea angustifolia.	Dithyræa Wislizenii.
Sida hederacea.	
Gaura parviflora,	Œnothera pallida
Glycyrrhiza lepidota.	
Sophora sericea.	Dalea scoparia.
Melilotus indica.	Delea lanosa
Franseria Hookeriana.	Prosopis juliflora glandulosa.
Baccharis glutinosa.	
Astera tanacetifolius.	Aster tanacetifolius.
Helianthus ciliaris.	Aster canescens.
Helianthus annuus.	Artemisia, sp.
Aster spinosus.	
Lepachys tagetes.	Lepachys Tagetes.
Flaveria repanda.	Pectis papposa.
Xanthium Canadense.	Pluchea borealis.
Erigeron Canadensis.	Bigelovia Wrightii.
Verbesina encelioides.	Baileya multiradiata.
Aphanostephus ramosissimus.	Aplopappus spinulosus.
Curcubita fœtidissima.	Maurandia Wislizenii.
Ipomœa Mexicana.	Abronia turbinata.
Cuscuta (C. Californica ?).	Abronia cycloptera.
Salvia lanceolata.	Nama hispidum.
Physalis (P. lanceolata ?)	Phacelia integrifolia.
Solanum elæagnifolium.	Gilia, sp.
Portulaca oleracea or retusa.	Eriogonum, sp.
Acanthochiton Wrightii.	Acanthochiton Wrightii.
Polygonum near erectum.	Atriplex canescens.
Chenopodium leptophyllum.	Oryzopsis membranacea.
	Ephedra, sp.

The sandhill list could readily be extended by further study. The purpose just now is merely to show that two radically different floras occur in the same immediate vicinity, at the same altitude, on different kinds of soil. Cultivated lands here vary from the very sandy to the almost pure adobe, and it may be assumed that they are thus adapted for very different crops, and require different methods of cultivation.

It will be at once remarked, from the data given in this and the preceding paper, that two quite different factors have had to do with the modification of the flora. In the one case the principal factor is the climate, in the other the soil. Nevertheless, the two are intimately connected, for the soil greatly modifies the effect of the climate. Another very important factor is shade, which is present in the Colorado case. Moisture, again, is controlled partly by the general climate and partly by the

general nature of the soil—not merely the surface soil, but the underlying beds.

The professional botanist will find these notes, if new in themselves, merely illustrative of general laws long familiar to him; but they are written in the hope that others may find them interesting, and may perhaps be stimulated to make similar observations elsewhere. It is surely desirable for horticulturists to pay more attention to such matters when selecting land and choosing what to grow upon it.

T. D. A. COCKERELL.

MESILLA PARK, N. M.

CURRENT NOTES ON PHYSIOGRAPHY.

THE NIAGARA GORGE.

WHEN the gorge of Niagara was first ascribed to work of the river, it was tacitly postulated that the volume of the water and the rate of recession of the falls had been constant. This postulate gave way before the suggestion that variations in river volume may have occurred during the disappearance of the ice sheet. Now it is attempted to correlate these variations in volume on the one hand with the retreating ice front, the northeastward elevation of the land, and the temporary discharge of the upper great lakes across Ontario, and on the other hand with the breadth and depth of the gorge. A recent paper by Taylor on the 'Origin of the Gorge of the Whirlpool Rapids at Niagara' (*Bull. Geol. Soc. Amer.*, IX., 1898, 59–84) explains the narrow part of the gorge, where it is crossed by the railroad bridges and occupied by the Whirlpool Rapids, as the work of the discharge of Lake Erie alone—that discharge being called the Erie-Niagara River—while the upper lakes ran to the St. Lawrence by the Nipissing-Mattawa channel, eastward from the then expanded Georgian Bay. Before the ice sheet had retreated far enough to open this outlet the upper lakes discharged through Erie, and the large volume of Niagara at that time caused the erosion of the wider gorge and deeper gorge just below and above the Whirlpool.

It is thus implied that the channel of Detroit River must have been laid dry while the Erie-Niagara was cutting its narrow gorge, and of this Taylor has found good evidence in the depth to which the valleys of small tributaries of the Detroit are eroded below the present river surface. The manner in which many independent factors are thus correlated is really of dramatic interest.

SOUTH CAROLINA.

L. C. GLENN describes the physical features of South Carolina (*Journ. School Geogr.*, II., 1898, 9–15, 85–92), giving a clear picture of the piedmont plateau and the coastal plain. The piedmont is a peneplain gently rolling over most of the surface, but much dissected by narrow and branching side valleys near the main streams. About the headwaters many rapids and falls interrupt the streams; farther down the valleys the larger rivers have opened narrow 'bottoms,' whose fertility has been much impaired by wash from carelessly farmed hillsides. The middle and outer parts of the plateau carry a number of monadnocks, such as Ruff's, Parson's, King's and other low mountains. On the inner part of the plateau the residual mountains are higher and more numerous, rising 1,000 to 1,500 feet above the peneplain. The coastal plain is hilly along its inner border, low and smooth over most of its extent. Here the chief rivers have broad swampy flood plains. The numerous channels that divide the islands along the coast are ascribed to the strong tides of the Carolina bight.

It may be noted in this connection that the *Journal of Geography*, edited by Professor R. E. Dodge, of Teachers College, New York, has published a number of first-hand

articles of value to teachers, and that it is now successfully entering on a second year. The *Journal* has commended itself to the Geographical Association of England, and one of their members has been at their suggestion appointed on the board of associate editors.

DUNES IN NORTH GERMANY.

THE drift plain of North Germany is intersected by broad valleys, many of which are the work of glacial rivers. Dunes are common on the valley floors, and those near the Elbe above Boizenburg are described by P. Sabban (Die Düne der sudwestlichen Heide Mecklenburgs * * * Mitth. Meckl. Geol. Landesanst., VIII., Rostock, 1897). It is suggested that the dunes were chiefly formed when the glacial waters were withdrawn, leaving extensive barren gravelly plains; and that dunes, therefore, do not indicate a period of dry climate. Many of them are now more or less overgrown; some are forested, and one of these is shown in an excellent plate. Small dunes and sand deposits are found on the uplands, where the sands are blown up from the valleys. Mention is made of the manner in which dunes shed water, so that after a heavy rain they are wet to a depth of only a few inches—a point to which Shaler has called attention in this country.

In this connection, it may be stated that Keilhack reports an advance of about 9 meters yearly for several travelling dunes near the Baltic coast (Jahrb. preuss. geol. Landesamt. (1896), 1897, 194–198), giving a good view of a heavy dune invading a pine forest.

W. M. DAVIS.

CURRENT NOTES ON METEOROLOGY.

THE GULF STREAM AND THE TEMPERATURE OF EUROPE.

MEINARDUS, in the *Meteorologische Zeitschrift* for March, finds a relation between the temperatures of the Gulf Stream waters off the Norwegian coast and the temperatures of central Europe, which relation he expresses as follows: I. A high (low) temperature in central Europe in the late winter (Feb.–Mar.) and early spring (Mar.–Apr.) usually follows a high (low) temperature of the Gulf Stream off the Norwegian coast in early winter (Nov.–Jan.). II. The greater the difference in pressure between Denmark and Iceland in the period September (or Nov.) to January, the higher is the temperature of the Gulf Stream and of the Norwegian coast in the same months (Nov.–Jan.), and the higher is the air temperature in central Europe in the succeeding months (Feb.–Apr.). III. The difference in pressure above noted has only an indefinite relation to the temperatures prevailing at the same time in central Europe, and no relation to the temperatures of May and June.

ATMOSPHERIC DUST.

A SERIES of interesting observations on the 'dust' of the atmosphere is described by Melander in a recent work ('Sur la condensation de la vapeur d'eau dans l'atmosphère,' Helsingfors, 1897), as noted by Maurer in the *Meteorologische Zeitschrift* for March. The investigation was carried on by means of the Aitken dust counter, and included 3,000 observations in Finland, the Sahara, and elsewhere. Some of the results are as follows: The number of dust particles increases with the dryness of the air, there being usually a minimum in the afternoon. Winds from the land carry more dust than those from over the water, and those blowing out of an anticyclone, or down from high mountains, are very dusty. Products of combustion furnish a portion of the dust particles which cause condensation in the atmosphere. The important problem as to whether or not precipitation can occur without the assistance

of dust particles is not yet solved, but it seems certain that where these particles are present they are the effective cause of the precipitation.

METEOROLOGICAL CONDITIONS OF THE KLONDIKE REGION.

IN the 'Klondike Number' of the *National Geographic Magazine* (April) General Greely has collected, in a brief article, what little is known about the climatic conditions of the Klondike district. The observations of most interest are those made at Dawson between August, 1895, and November, 1896. From December 1, 1895, to February 1, 1896, the temperature fell below zero every day. It was below −40° on 28 days; below −50° on 14 days, and below −60° on 9 days. The January, 1896, mean was −40.7° and the February mean −35.4°. Bright weather is the rule in winter, and from October 1, 1895, to May 1, 1896, snow fell only on one day in seven. During June, July and August, 1896, the temperature rose above 70° on 29 days and above 80° on 3 days. July was the only month in which the minimum did not sink below freezing. In June it rained on 12 days. Observations at Fort Reliance, near Dawson, made in 1880–81, gave December, January and February means of −31°, −7° and −29° respectively. The thermometer registered between −40° and −66° on 35 days. Snow fell on but one day in February, and 25 days were perfectly clear.

CLIMATE AND COMMERCE.

THE control of the severe winter cold of Russia and Siberia over the commerce of those countries is well known, the blockading of their great ports by ice during the winter being one of the serious drawbacks in the development of their import and export trade. But now the ingenuity of man comes into play, and by means of huge steam rams it is found possible to keep open many of the important harbors throughout the cold season. Vladivostok now has a steam ram which is effective in keeping open its harbor. In Finland the port of Hangö is also kept open by a steam ram, and Admiral Makarof, of the Russian navy, thinks it perfectly feasible to maintain communication, through the winter, between the sea and the port of St. Petersburg. The struggles of man to overcome the difficulties which nature, through climate, puts in his way are among the most interesting of his many activities.

RECENT PUBLICATION.

FRANK H. BIGELOW: *Abstract of a Report on Solar and Terrestrial Magnetism in their Relations to Meteorology.* U. S. Department of Agriculture, Weather Bureau, Bulletin No. 21. Washington, 1898. 8vo, pp. 176, Chs. 39.

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CURRENT NOTES ON ANTHROPOLOGY.

MEXICAN ARCHÆOLOGY.

IN the *Journal of American Folk-Lore* (Vol. X., No. 39), Mrs. Zelia Nuttall has an article on 'Ancient Mexican Superstitions' containing much information from early and scarce authorities relating to the beliefs current among the natives at the time of the conquest. Her conclusion is that most of the superstitions were simple and harmless and sprang from the same mental sources as those which prevail in civilized countries to-day.

A full description of the remarkable temple-pyramid of Tepoztlan, south of the City of Mexico, is published by Dr. Seler in *Globus* (Bd. 73, No. 8). It is illustrated with twenty-two engravings, plans and views, and contains the identification of a number of the hieroglyphic inscriptions. The gods to whom the temple was dedicated appear to have been those connected with agriculture.

THE SMITHSONIAN REPORT FOR 1895.

This report, which has just been issued, contains two lengthy articles of unusual value to the student of American anthropology.

The first is by Dr. Franz Boas, on 'The Social Organization and Secret Societies of the Kwakiutl Indians.' It covers 430 pages, is abundantly illustrated, and the material, personally collected by the author, is presented with care and accuracy. Many songs are given, with the original text, an interlinear translation and the accompanying music. It is a contribution of rare worth to our knowledge of aboriginal thought.

The second article, of 230 pages, is by Dr. Walter J. Hoffman, on 'The Graphic Art of the Eskimos.' This is a subject on which the author has been collecting for many years, and his descriptions seem to be exhaustive. The illustrations are abundant and beautiful, and the development and connections of the Eskimoan cultures are set forth with detail.

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

The *Chemical News* for April 1st contains a paper read by Professor Andrew Gray and Professor J. J. Dobbie before the Royal Society 'On the Connection between the Electrical Properties and the Chemical Composition of Glass.' Previous experiments had shown that resistance in flint glass was greater than in potash- and soda-lime glass. Two of the glasses in the present series were specially made flint glasses with very high content of lead. Previously a glass with 40.5% lead oxid showed specific resistance of $8,400 \times 10^{10}$ ohms. Of the new glasses, one with lead oxid 42.14% gave a resistance too high to measure, but certainly over $18,000 \times 10^{10}$ ohms at 130°, while one with 46.6% lead oxid gave above $35,000 \times 10^{10}$ ohms at all temperatures to 135°. A barium crown glass, which was a borosilicate of barium and aluminum showed a specific resistance above $59,000 \times 10^{10}$ ohms up to 140°. A 'Jena' glass, which is essentially a borosilicate of zinc, sodium and magnesium, showed a resistance of 596.5×10^{10} at 43° and 0.2×10^{10} at 140°. This low resistance was to be anticipated from the high percentage of soda, but the very high resistance of the barium glass was unexpected, as this glass might have been supposed to resemble a lime glass rather than a lead glass. While it is possible this may be influenced by the boric acid present, it may also prove true that the resistance is rather affected by the high atomic weight of the barium. The 'Jena' glass showed very considerable polarization effects, and the same was true of the lead glass, while the barium glass showed little or no sign of polarization.

The same number of the *Chemical News* contains an article by P. Truchot, taken from the *Revue générale des sciences* on the occurrence of thorite, monazite and zircon. The monazite in western North Carolina is richest in thorium and occurs in sands from a coarse mica rock. The monazite crystals are plainly seen disseminated in the rock. When the rock contains gold the monazite constitutes a very valuable by-product. Monazite is found in Idaho, where it is one of the original constituents of Idaho granite. Sands from the lakes of Idaho City have yielded, after washing, monazite sand containing 70% monazite. The European supply comes almost exclusively from the sea-shore sand in southern Bahia, Brazil. The sand is loaded directly and with very little expense on board ships. It contains 4 or 5 per cent. of thoria. Deposits of monazite are also found in Canada (Villeneuve mine, Ottawa), in several different States of Brazil, and in several other countries of South America. Zircon is

widely distributed, but the most important deposit, discovered last year, is on the northeast side of 'New Zealand' (*sic*, Tasmania), midway between Enim Bay and Circular Head. The deposit covers an area of 105 acres and has a thickness of 20 centimeters. It is composed almost entirely of zircon and is extracted simply by washing. It runs 62 to 64 per cent. zirconia, with variable quantities of the other rare earths. The author, in conclusion, states that the supply of rare earths tends to increase more and more, and, great as may become the development of incandescent gas-lighting, the demand can never exceed the supply.

IN a paper before the Cambridge Philosophical Society, Messrs. Heycock and Neville continue their studies of alloys, exhibiting Röntgen-ray photographs of plates of various gold alloys. In gold-sodium alloys with less than 30 per cent. gold they consist of well-developed, very transparent crystals of sodium in a matrix which contains gold. Alloys with more than 30 per cent. gold show very opaque needles of gold in a less opaque matrix, which was the same as the matrix of the former alloy. Similar results were obtained with gold-aluminum and gold-copper alloys. The gold-aluminum alloys showed well-defined crystals of Roberts-Austen's compound $AuAl_2$.

IN the *Comptes Rendus* E. Finck describes three compounds formed by the action of carbon monoxid on palladium chlorid, $PdCl_2,CO$, $PdCl_2(CO)_2$, and $(PdCl_2)_2(CO)_3$. These compounds are interesting in that they are analogous to the similar compounds of carbon monoxid with platinous chlorid. J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE RECENT ECLIPSE OF THE SUN.

IN the last number of the *Independent* Professor C. A. Young condenses from the *Observatory* an account of a recent meeting of the Royal Astronomical Society devoted to the solar eclipse at which several of the observers presented preliminary reports of their work, and exhibited some very interesting photographs of the corona, and of various eclipse spectra. Professor Young writes:

According to Professor Turner's photographs (and, of course, all the others agree substantially, which is by no means the case with visual observations of that phenomenon), the corona was of the type expected and predicted for the present stage of the sun-spot period. It had the form of an irregular four-rayed star, with long streamers projecting from the sun-spot zones to a distance considerably exceeding the sun's diameter, and others, shorter and narrower, but more distinct in outline, from the polar regions. In one of the long streamers Professor Turner's polariscopic camera showed distinct polarization, indicating the presence of something besides gas—dust or mist of some kind.

The corona was hardly as bright as usual, so that Mr. Newall did not succeed in his attempt at a spectroscopic determination of its rotation; but Captain Hills, of the Astronomer Royal's party, was able to get fine photographs of its spectrum, and to reobserve the violet lines first detected in 1893, and to determine their position accurately.

He also obtained (and with a *slit*-spectroscope, a new success) excellent photographs of the 'flash spectrum.' It shows hundreds of bright lines, and so far is in entire agreement with the visual observation of the writers' made twenty-seven years ago; but Captain Hills agrees with Sir Norman Lockyer that it cannot be described as a reversal of the Fraunhofer lines, as regarded by most astronomers, because 'the lines have different relative intensities; strong Fraunhofer lines are absent in the flash, and bright lines are present in the latter which are absent, or very faint, in the solar spectrum.' Mr. Fowler, Sir Norman Lockyer's assistant, was also present with his prismatic-camera negatives, and concurred with Captain Hills on this point. Both gentlemen, however, have always been faithful followers of Lockyer in his peculiar views, and took the same ground in regard to Mr. Shackleton's photograph in 1896.

In this case the comparison of the flash-spectrum with an ordinary solar spectrum of the same dispersion seemed to the writer, and to nearly all who made the examination, to indicate that the former was simply a combination of the spectrum of the chromosphere with a reversed Fraunhofer spectrum. In the region of the spectrum covered by the photograph only one conspicuous Fraunhofer line is missing from the flash, and there is no difficulty in plausibly explaining such an absence, or in accounting for the other considerable discrepancies of relative intensity. It is to be hoped that astronomers in general may soon have the opportunity to study some of these new photographs for themselves. It is interesting to note that a little later in the evening Mr. Evershed showed photographs of the violet region of the spectrum, made only eighteen seconds after totality; and in these, 'apparently *every* dark line of the Fraunhofer spectrum ends in a short bright line,' just as it should on the accepted 'reversing layer theory.' Clearly the matter cannot yet be regarded as settled.

In a very real sense the eclipse observations are still going on—in the study, measurement, comparison and discussion of the photographs. These records, authentic and permanent, will probably in time supply such data as will warrant an authoritative decision of the question. Very likely, too, they will go far toward the solution of some of the other 'pending problems' of solar physics, and quite possibly they will present new ones still more perplexing. But the complete and final report cannot be expected for some months yet.

THE PHILADELPHIA ZOOLOGICAL GARDEN.

THE annual meeting of the Board of Directors of the Philadelphia Zoological Society was held on April 28th. The report of the Secretary, according to the account in the Philadelphia *Ledger*, stated that there are now 1,981 members, of which number 1,330 are life, 360 annual and 261 perpetual. The record of admissions to the gardens shows 173,999 during the year ending February 28th, which is an increase of 369 over 1897. In addition to these, 125,000 tickets were issued for the pupils of the public schools. The receipts from gate admissions aggregated $23,908.

The report of Treasurer Henry T. Coates shows total receipts of $38,359.11, including $10,000 appropriated by the city; the expenses amounted to $38,191.35, leaving a balance of $167.76. The sum of $3,806.30 was spent for for the purchase of animals.

There are now in the gardens 1,019 living animals, including 339 mammals, 421 birds, 238 reptiles and 21 batrachians. The total number of specimens received during the year was 735. Among the more important acquisitions is a rare species of whip snake, received from Herbert Browne, of Tucson, Arizona.

On April 23d two young West Indian seals were purchased in Pensacola, Fla. The report states that, although the existence of a peculiar species of seal in the Caribbean Sea has long been known, no detailed description had been given of it until very recently, and no living specimens have been secured until a schooner was sent out last spring for the purpose of capturing some, which it finally effected off Yucatan. It was hoped that observations might be made upon the habits of this almost unknown species, but, unfortunately, in all the cases the animals were with difficulty induced to take food, and lived but a short time.

A male dromedary was purchased in Baltimore on the 2d of November, and a few weeks later a female Bactrian camel was received. The original stock of camels of both species, which had been for many years in the gardens, has now entirely disappeared, due largely to continued inbreeding.

The principal loss by death was the male orang 'Chief,' November 3, 1897. This animal was received at the gardens November 16, 1893, and was, perhaps, as fine a specimen of his kind as any which have been exhibited. The autopsy showed the animal to have been in such complete health that the accidental nature of his death was greatly to be regretted. It is worthy of note that, while it has more than once been pronounced by high authority to be anatomically impossible for the orang to maintain an erect attitude without touching some means of support, this animal was repeatedly observed walking about his cage in an abso-

lutely erect position without having his hands in contact with any fixed object.

The outside cages at the new monkey house were erected and put into use during the summer, thus finally completing what is without doubt the most pleasing and well adapted building on the grounds. Plans have been prepared for a house for small mammals, to be erected upon the site of the old monkey house, all of which will be torn down, with the exception of the stone portion of the outer walls.

A large piece of ground lying between the Carnivora House and the eastern main walk has been enclosed by an iron fence, to contain the elk and a similar pen, has been made for common camels on the opposite side of the walk to the west.

A similar construction is projected on the western main walk, opposite the Carnivora House, for Bactrian camels. The removal of the elk and camels from the series of pens on the western side of the gardens has made it possible to give the American buffalo the whole space, measuring some 420 feet in length, with a depth of from 110 to 180 feet. While the conditions afforded by such an enclosure fall far short of those which are to be desired, they are probably as good as can be supplied in a zoological garden of average size, and, on the whole, the condition of the herd of buffalo owned by the Society is most gratifying.

SOLOMON STRICKER.

We take from an obituary notice in *The British Medical Journal* the following details regarding the life and work of the late Professor Stricker.

Born in 1834 in Waag-Neustadt, in Hungary, he studied in Pressburg and Ofen Pest; afterwards he went to Vienna, where he 'inscribed' as a student of law, but soon turned to medicine. In his second year of medical study he began to work under Brücke (1855–58). In 1858 he graduated as M.D.; in 1859 he became Assistant in the General Hospital, in 1862 a *Privat-docent* for 'Entwicklungsgeschichte,' and in 1863 he again became Assistant to Brücke. In 1865 he published his discovery of the diapedesis of the red blood corpuscles and the contractility of the capillary wall. At the end of the war of 1866 Cohnheim was in Vienna, where began a friendship between these two. In 1866 Oppolzer selected Stricker to develop the experimental method as applied to physiology and pathology in his clinic. Through the strong friendship which sprang up between Stricker and Rokitansky, Stricker in 1868 was nominated professor (extraordinarius) of experimental pathology, with a very modest and limited laboratory. In 1869 appeared his *Studien a. d. Institute f. exp. Pathologie.* In 1870 he visited England, and in 1871 his then assistant, Dr. Klein, came to London.

In 1871–73 appeared his *Handbuch d. Lehre v. d. Geweben d. Menschen u. d. Thiere* (translated in 3 vols., New Sydenham Society, *Human and Comparative Anatomy*). Chiefly through the influence of Rokitansky, Stricker was nominated professor of general and experimental pathology. The chief results of the work done by his pupils in his laboratory were edited by Stricker, and published in the well-known *Med. Jahrbücher* (1871–80). In 1877–83 appeared his *Vorlesungen über allgem. u. exp. Pathologie.*

Stricker recognized the importance of experimentation for the advancement of medicine, and, although in his course in 1883 he confined himself to histological demonstrations, he soon developed an auditorium replete with apparatus for all kinds of experimentation, and so arranged that everyone in the audience could profit thereby. He laid great stress on this subject in his lectures, which were often attended by over 400 students.

Stricker regarded the study of tissues not as an end, but as the means of ascertaining the course of events in living tissues; he studied not so much tissue morphology as tissue physiology, and to this end he invented his 'hot stage.' Stricker, through his pupils, also contributed much to our knowledge of vasomotor nerves, efferent fibres in the posterior roots of spinal nerves, the action of diuretics, the anæsthetic action of cocaine, etc.

Besides strictly medical papers, Stricker published several philosophical works: 'Studien über Bewusstsein' (1879), 'Sprachvorstellung' (1880), 'Bewegungsvorstellung' (1882), 'Association d. Vorstellungen' (1883), and 'Physiologie d. Rechts' (1884).

In all he published 134 papers from his own pen, and under his direction over 400 were published by the pupils—numbering 123—who worked in his laboratory under his direction. Of these pupils 45 are already professors and 17 *Privatdocenten.*

Stricker lived very much apart and went very little into society. What interested him he fought for, regardless of consequences. Perhaps his position in Vienna in later years may be summed up in the words of one of his assistants—Georg Kapsammer—from whose short biographical notice of Stricker most of the above facts are taken: "Stricker's life was one rich in work, rich in results, rich in disputes; rich in luck and honors it was not."

GENERAL.

PROFESSOR WILLIAM JAMES, of Harvard University, has been appointed Gifford lecturer to the University of Edinburgh for the years 1899–1901. He will give two courses of ten lectures each on 'Natural Religion.' Professor James has also been elected correspondent of the Institute of France (Acad. des Sciences morales et politiques).

PROFESSOR J. M. SCHAEBERLE has resigned his position as astronomer at the Lick Observatory. The Regents of the University of California have accepted the resignation, to take effect after one year, with leave of absence and salary for the year.

M. DESLANDRES, whose astrophysical work is well known, has been transferred from the observatory at Paris to the astrophysical observatory at Meudon.

THE freedom of the city of Edinburgh will be conferred on Lord Lister on June 15th.

THE University of Aberdeen has conferred its LL.D. on Dr. Charles Chree, Superintendent of Kew Observatory. The University of Edinburgh has conferred the same degree on Mr. Horace T. Brown, F.R.S.; Professor D. G. Ritchie and Professor J. V. Carus, of Leipzig.

DR. H. M. FERNANDO will, says *Nature*, probably be the Director of the Bacteriological Institute to be opened in Colombo shortly. The final plans for the building have been completed, and the work will be taken in hand at once. It is expected that the Institute will be opened by the beginning of next year.

THE Council of the University of Paris has appointed MM. Milne-Edwards and Blanchard delegates from the University to the approaching meeting of the International Zoological Congress.

M. KUNCKEL D'HERCULAIS, the French naturalist, has, at the request of the Argentine Republic, been entrusted with the establishment and conduct of a bureau of economic entomology at Buenos Ayres.

THE Council of the Linnæan Society has, as we have already announced, decided to award the Society's gold medal for the year to Mr. G. C. Wollich, in recognition of his valuable scientific labors connected with the investigations of the biological conditions of the deep sea. Regarding this event the London *Times* relates that it is now nearly forty years since Mr. Wollich accompanied Sir F. L. McClintock in her Majesty's ship *Bulldog* on an expedition despatched by the British government for the preparatory survey of the route for the telegraph cable between England and America. Notwithstanding that dredging was foreign to the object of the expedition, Mr. Wollich obtained materials, slender and fragmentary as they were, which led to his discovery of the existence of a deep-sea fauna. Though some of his opinions and conclusions have not survived the test of subsequent research, many of them have been established on conclusive proof. Dr. John Murray, of the *Challenger*; Dr. Günther, President of the Linnæan Society, and Mr. George Murray, of the Botanical Department of the British Museum, have all borne testimony recently to the value of Mr. Wollich's work.

A COMMITTEE, with the Mayor of Boulogne as Chairman, has been formed for the purpose of erecting a monument to the memory of 'Duchenne de Boulogne.'

A BUST of the late Professor P. Schützenberger was unveiled at the Paris École de physique et de chimie industrielles, of which he was the first Director, on April 3d.

WE regret to record the death of Dr. Georg Dragendorff, professor of pharmacy at Rostock, at the age of 62 years, and of Dr. F. Sand-

berger, professor of mineralogy at Würzburg, aged 72 years.

MR. MELVILLE ATWOOD, geologist and metallurgist, died on April 25th, at Berkeley, Cal. He was born in Worcester, Eng., on July 31, 1812, and went to the gold and diamond mines of Brazil at an early age. In 1843 he made a discovery that increased the commercial value of zinc ore. He came to California in 1852, and invented and introduced the blanket system of amalgamation. He was a member of the Academy of Science and of the Microscopical Society of San Francisco, and a Fellow of the Geological Society of London.

REFERRING to the recent death of Professor Aimé Girard at the meeting of the Paris Academy on April 12th, M. Th. Schloesing, according to the translation in *Nature*, remarked: "M. Aimé Girard was the highest authority on chemical and agricultural industries in the Academy. After some valuable scientific work he was nominated professor of industrial chemistry at the Conservatorie des Arts et Métiers, in succession to Payen. His teaching revealed the dominating object of his efforts. Affable and cheerful, loyal and entirely disinterested, he possessed all the attributes required to gain the confidence of manufacturers. The producers whose places he visited, in France and in other countries, became and remained his friends; they gave to him a large amount of information which he used to enrich his attractive lectures, and in return M. Girard offered them advice suggested by his experience and his own investigations. In a few years his masterly researches on vegetable fibres, wheat, farinas, sugars and woods had made him the first authority upon these matters, and he was frequently consulted by the government on subjects concerning the great industries of paper, alcohol, sugar, flour and bakery. The study of these products led to inquiries as to crops. In this new direction M. Girard rendered valuable services, and, after his researches on the cultivation of sugar-beet and the improvement of the potato, he obtained among agriculturists the same position and the same sympathies which he enjoyed in the industrial world. Though weakened in recent years by illness, and saddened by repeated troubles, he nevertheless continued his work. He died while occupied in applying to wheat of various origins the new methods of analysis which were the subject of a recent communication to the Academy. The vacancy which his death has caused enables us to estimate the high place which he occupied in scientific societies and in the committees in which he took part."

THE Sanitary Institute of Great Britain will hold its next meeting in Birmingham, commencing on September 27th. Sir Joseph Fayrer, Bart, is the President.

THE twenty-seventh Congress of German Surgeons was opened on April 13th in the hall of the Langenbeckhaus in Berlin by the President, Professor Trendelenburg, of Leipzig. About 300 members were present. A donation was announced of 50,000 Marks from the Langenbeck family, the interest of which sum is to be devoted to studies in military surgery. Professor Hahn, of Berlin, was elected President for the next Congress.

THE Société Français de Physique held its annual exhibition of apparatus in its rooms on April 15th and 16th. Addresses were made by MM. Ducretet, Morin and Hurmuzescu.

THE regular public lecture for April of the N. Y. Academy of Sciences was given on the 27th inst., by Dr. James Douglas, his subject being the progress of mining and metallurgy during the last half century.

AT the Paris Museum of Natural History, M. Stanislas Meunier has begun a course of lectures on experimental geology in which he will discuss the attempts that have been made to reproduce artificially geological phenomena.

MR. HARVEY will give, at the approaching annual meeting of the Paris Academie des Inscriptions, an address on the introduction, in 1647, of the teaching of chemistry in France through the Scotchman Davisson.

WE referred recently to the efforts of the Prince of Monaco for the establishment of an observatory in the Azores for meteorological, seismic and other observations. He addressed the Royal Society on the subject last week and proposed that the observatory be made international in character.

UNIVERSITY AND EDUCATIONAL NEWS.

DOCTORATE FELLOWSHIPS AT THE UNIVERSITY OF CHICAGO.

THE Senate of the University of Chicago, acting upon the recommendation of the Graduate Faculties, has proposed, for the consideration of the Trustees, the following plan for more advanced fellowships:

For the purpose of encouraging research as distinguished from the purpose of encouraging less advanced students to secure training to qualify them for research, the University offers Doctorate Fellowships upon the following conditions:

1. Candidates shall have received the degree of Doctor of Philosophy from the University of Chicago.

2. Candidates must specify in detail the line of investigation which they wish to pursue, and they must obtain the unanimous endorsement of the officers of the department or departments within which the proposed work falls.

3. Incumbents are expected to devote at least nine months of each year exclusively to their research work at the University. They may, however, by special permission, carry on excavation, exploration or consultation of original material wherever the problems under investigation may demand.

4. Doctorate Fellows are expected to prepare the results of their researches for publication. This work is accepted in lieu of all teaching or other service to the University during occupancy of the Doctorate Fellowship.

5. In cases of exceptional ability, students of independent means who have received the degree of Doctor of Philosophy may be made Honorary Doctorate Fellows without income from the University. With this exception, their relationship to the University will be the same as that of regular Doctorate Fellows.

6. The income of each Doctorate Fellowship is seven hundred and fifty dollars ($750.00) per year. Appointments are made annually, but incumbents are eligible to reappointment for a total term not exceeding five years.

7. It is assumed that Doctorate Fellows need no formal instruction, but that they may pursue their researches independently. They are, therefore, exempt from payment of the regular tuition fees. They are required, however, to pay the special laboratory fees and to pay for the material used in their researches.

GENERAL.

A FELLOWSHIP in architecture of the value of $2,000 has just been established in Cornell University.

AMONG the recent appointments at the University of New Mexico at Albuquerque are the following in science: Professor E. P. Childs, formerly of Denison University, assumes charge of physics and chemistry; Professor John Weinzirl, late of the Wisconsin Experiment Station, is director of the bacteriological laboratory and assistant professor of biology; Mr. F. S. Maltby, late of Johns Hopkins, is assistant in the bacteriological laboratory, and Mr. E. G. Coghill, of Brown, is laboratory assistant in biology. A rather unique plan for a summer school in geology and mining has been adopted. A field class will spend two months in the study of the exceedingly interesting area containing the Magdalena mountains, doing careful topographical and geological work and completing a geological map of the region. A practical study of faults in their influence on the various mining problems will be made, and also practical observation of the routine work of a smelter and concentration plant in all the details. The party is under the immediate direction of President Herrick, of the University, who has minutely studied the region. A few students of geology and mining engineering can be accommodated if properly introduced. The only fee is ten dollars for entrance and only half a dozen can be accommodated from outside the Territory. Collections in botany, zoology and paleontology will be made.

THE New York University has given out the program of its fourth summer session for teachers and college graduates. Thirty courses are offered in eight different departments. The session will be held at University Heights, New York City, July 5th–August 19th.

AT the Cornell University Summer School

(Ithaca, N. Y.), Professor Geo. F. Atkinson offers five courses in botany during the summer of 1898 (Six weeks, from July 5th–August 13th). Three of these courses are especially designed to meet the wants of teachers in the high schools, and one course is to satisfy a growing desire for information concerning mycology.

THE Faculty of the University of Nebraska, after long consideration, have recommended the establishment of three 'general' groups or courses, viz., classical, literary and scientific, for the large class of students who desire general culture rather than specialization along any particular line. In these general groups fully three-fourths of the subjects are prescribed. In every case the aim has been to give the student an introduction to several of the principal lines of modern intellectual activity, without taking him into those phases of each subject which belong to the specialist. For the specialists in language, literature, history, economics and science the groups or courses hitherto existing will be still more extended to meet a growing demand.

THE University of Nebraska is erecting the north wing of its new Engineering Hall, to supply additional rooms for the work in electrical and mechanical engineering. Externally the walls are to be faced with chipped bricks, while all the interior surface is to be of smooth brick finish. This wing will provide about 21,000 square feet of floor space, which is a little less than one-half of the whole building.

AT a recent meeting of the Regents of the University of Nebraska the office of 'Dean of Women' was created, and Mrs. H. H. Wilson, of the class of 1880, was elected to the new office. She will assume her new duties at the opening of the next collegiate year. At the same meeting the Regents took action looking to the development of a department of domestic economy, and Miss Rosa Bouton, M.A., of the class of 1891, was elected to take charge of the work. Miss Bouton has been for six years an instructor in chemistry in the University and has already made considerable progress in the development of work in domestic chemistry.

PROFESSOR JAMES SHELDON, of the University of Wisconsin, has been elected professor of electrical engineering in Lafayette College.

DR. JAMES H. LEUBA, who was elected a year ago associate in psychology and pedagogy at Bryn Mawr College, will begin his courses next year. The fifth floor of Dalton Hall is being adapted to the requirements of a psychological laboratory, and the necessary apparatus is being procured.

WILLIAM B. HAMPSON, B.M.E., instructor in graphics and machine design in the University of Nebraska from 1893 to 1897, has been appointed mechanical engineer for the Oregon lines of the Southern Pacific Railway, with headquarters at Portland, Oregon. Frederic E. Clements, instructor in botany in the same University, has declined an election to the chair of plant pathology in the Maryland Agricultural College.

DR. F. NOLL, of Bonn, has been appointed professor of botany and director of botanical instruction at the Agricultural Academy at Poppelsdorf, in the place of Professor Friedrich Körnicke, who has resigned.

DISCUSSION AND CORRESPONDENCE.

ISOLATION AND SELECTION.

TO THE EDITOR OF SCIENCE: Mr. Hutton's letter in the last number of SCIENCE on 'Isolation and Selection' gives occasion to speak of a common misconception regarding the nature of evolution. So long as we proceed on the fundamental assumption that an organism, left to itself, will continue indefinitely to reproduce its like, neither Isolation nor Selection can be of any service in evolving characters *unlike* those of its ancestors. If heredity, the principle of breeding true, be assumed to be the fundamental principle controlling the generation and development of organic bodies, then the most favorable conditions of existence will be those least interfering with the operation of this principle, and the fittest race, or line of generating individuals, will be that one which reproduces its kind with greatest precision.

The very fact that isolation, or change of environmental conditions, results in increased de-

parture from the ancestral type is evidence that the hereditary principle is not the dominant one in organic activity, not the motive power, so to speak, which keeps up the continuity of living. Heredity is rather to be considered as the resultant of the total constraints and interferences of environment, an equilibrium established between the medium in which the organism lives and its own intrinsic energy. Hence, we may speak of heredity as acquired, while variation, change or evolution is that fundamental principle in all vital activity which constitutes the chief distinctive characteristic of living organic bodies.

It is expressed in the chemical phenomena of metabolism, in which there is a diversion from the normal relations of stability of equilibrium among atoms, up to a state of instability and complexity of composition; physically it is expressed in the phenomena of the cellular bodies passing from rest, simplicity and relative homogeneity, up to states of activity, multiplicity and heterogeneity and the development of the individual; and evolution of a race, or the acquirement of characters not possessed by ancestors, is a still higher exhibition of the same principle.

Undoubtedly Darwin, writing the 'Origin of Species,' thought he had discovered, in Natural Selection, the chief cause of this evolution, and evolutionists have since been following his lead. But a calm review of the facts in the case must convince us that we are no nearer finding the cause of evolution than we were before Darwin. In explaining, so far as we have, the Origin of Species, we have been discovering the relations which natural selection, isolation and other so-called 'factors of evolution' bear to the production of those temporary vortices in the path of evolution which we call 'individuals' and 'species.' The method of action of these 'factors' is by inducing the repetition of favorable steps of variation, swinging them back into cycles of reproduction, and thus making species where favorable conditions exist; in other words, the method is by establishing the habits or laws of heredity within organisms.

It is the recognition of the evolution principle as fundamental that puts us on the right path of discovery. What we have to account for is not the evolution, but the haltings of evolution in the various stages of cell, individual and species.

Given material particles, in motion, in a resisting medium, and vortices are explainable; but no amount of change in the medium is capable of accounting for the initiation of motion in particles normally at rest.

H. S. WILLIAMS.

NEW HAVEN, CT., April 26, 1898.

TO THE EDITOR OF SCIENCE: Kindly allow me space for a word of comment on the letter of Professor W. H. Hutton in your issue of April 22d.

Professor Hutton protests against the use of the term Selection in certain cases, saying: "Selection means the act of picking out certain objects from a number of others, and it implies that these objects are chosen for some reason or other." As he refers to my views later on I think it possible that he has seen the table which I published in this JOURNAL, November 19, 1897, reprinting it from a book of mine, in which I note twelve sorts of 'selection' in the current literature of evolution. Seeing that the definition given by Mr. Hutton is pre-Darwinian, and that much of the warfare which Darwin and subsequent evolutionists had to wage was precisely over this term Selection, leaving aside the question whether Darwin chose the term wisely or not in the first instance, it is scarcely possible now to go back to the pre-Darwinian view which Professor Hutton advocates. Indeed, he himself, in this letter says concerning natural selection: "The term has become so firmly established that it can well be allowed to pass if used only in Darwin's sense of advantage gained in the struggle for existence, either by the individual or by the species."

This admitted, there is only one thing to do, that is to recognize the two general uses of the term Selection, the pre-Darwinian (or conscious) Selection, 'for some reason or other,' and the Darwinian (or post-Darwinian) Selection of which *survival on ground of utility* is the sole criterion. Now it is true enough that all sorts of confusion arise from the interchange of these two sorts of selection; and it was with a view

to the correlation of the different conceptions under certain headings ('means' and 'result') that I drew up the table. At the same time, I recommended that Selection in the Darwinian sense should be used only when the essential conditions of organic progress by survival are present, namely, variations* and physical heredity. These requirements the different usages of the table do fulfill; so that as each has its qualifying word ('natural,' 'sexual,' 'organic,' etc.), the use of the term Selection is not ambiguous. Further, in Selection of the pre-Darwinian sort, as defined by Professor Hutton, *whenever it is a question of organic evolution*, these two conditions are also requisite, *i. e.*, variation and heredity, as in Darwin's artificial selection. So while I fully agree with Professor Hutton on the need of sharp definition of Selection, I do not see the need of taking our nomenclature back to pre-Darwinian zoology. Moreover, the attempt would be quite futile.

Professor Hutton goes on to say that Darwin's term 'Natural Selection' is better than 'Organic Selection.' He seems to suppose that the two are used for the same thing. As the proposer of 'Organic Selection' (and all the other users of the term, so far as I know, *e. g.*, Osborn, Ll. Morgan, Poulton, etc., have given it the same meaning) I have only to say that nothing of that sort is intended. Organic Selection is supplementary; it is based upon and presupposes Natural Selection. † It recognizes the positive accommodations on the part of individual animals by which they keep themselves alive and so have an advantage over others *under the operation of natural selection.* I agree with Professor Poulton in holding ‡ that, so far from coming to replace natural selection or impair our confidence in it, it does quite the reverse. And I also think that it explains phenomena of 'determinate evolution' which are not fully explained by natural selection alone. So some such new term is justified; and it is really a

*I there said natural selection and physical heredity, but the first requisite is really the supply of variations.

†See my papers in the *American Naturalist*, June, July, 1896.

‡SCIENCE, October 15, 1897, and *Nature*, April 14, 1898, p. 556.

form of 'selection' in the Darwinian sense, for it requires both variations and physical heredity. Moreover, it is contrasted with natural selection on a point of which Professor Hutton speaks. He says: "Natural Selection is not truly selection, for the individuals can hardly be said to select themselves by their superior strength, cunning, or what not." Now, 'organic selection' supposes them doing this, in an important sense. It is a sort of artificial selection *put in the hands of the animal himself*—that is, *so far as the results go.*

As to 'isolation' (Professor Hutton's other topic), it is certainly important, but is Professor Hutton right in considering it a positive cause? He says: "It is isolation which produces the new race; selection merely determines the direction the new race is to take," and "isolation is capable of originating new species." But how? Suppose we isolate some senile animals, or some physiological minors, will a new race arise? The real cause in it all is reproduction, heredity with its likenesses and its variations. Both isolation and natural selection are negative conditions: what are called in physical science 'control' conditions, of the operation of heredity. So in seeking out such principles as 'selection,' 'isolation,' etc., we are asking how heredity has been controlled, directed, diverted, in this direction or that. Isolation is as purely negative as is natural selection. Any influence which throws this and that mate together in so far isolates them from others, as I have said in a notice of Romanes' and Gulick's doctrine of isolation, * and inasmuch as certain of these control conditions have already been discovered and otherwise named by their discoverer as 'natural selection,' 'artificial selection,' 'sexual selection,' etc., it is both unnecessary and unwise to attempt now to call them all 'isolation.' For if everything is isolation then we have to call each case by its special name, just the same, to distinguish it from others.

There remains the question as to whether isolation, in the broad sense of the restriction of pairing to members of a group, can result in specific differences without any help from 'selection' of any kind. If that should be

* *Psychological Review*, March, 1898, p. 216.

proved,* then there would be, it would seem, justification for the term 'isolation' in evolution theory, with a meaning not already preempted. This Professor Hutton claims, with Romanes and Gulick.

J. Mark Baldwin.

Princeton, April 26, 1898.

A VIEW OF THE OHIO VALLEY IN 1755.

Apropos of the interesting historical essay by Mr. Baker (Science, April 22, 1898), allow me to refer to an early and highly appreciative account of the Ohio valley by Lewis Evans, a clear headed contemporary and townsman of Franklin's, and the author of a 'Map of the Middle British Colonies in America,' with a descriptive text published in 1755.

Among other praises, he wrote: "Ohio is naturally furnished with salt, coal, limestone, grindstone, millstone, clay for glass-houses and pottery, which are vast advantages to an inland country, and well deserving the notice I take of them in the map. * * Were there nothing at stake between the crowns of Britain and France but the lands on that part of Ohio included in this map, we may reckon it as great a prize as has ever yet been contended for between two nations; but if we further observe that this is scarce a quarter of the valuable land that is contained in one continued extent, and the influence that a State vested with all the wealth and power that will naturally arise from the culture of so great an extent of good land in a happy climate, it will make so great an addition to that nation which wins it, where there is no third state to hold the balance of power, that the loser must inevitably sink under his rival."

While thus urging His British Majesty to dispute with the French the acquisition of the great Ohio country, Evans argues curiously against any dangerous influence that such an increase of possessions might have on the loyalty of the colonies. "Supposing the Colonies were grown rich and powerful, what inducement have they to throw off their independency? * * * Each colony having a particular form of government of its own, and the jealousy of either having the superiority over the rest, are unsurmountable obstacles to their ever uniting to the prejudice of England upon any ambitious views of their own. But that repeated and continued ill usage, infringements of their dear-bought privileges, sacrificing them to the ambition and intrigues of domestic and foreign enemies, may not provoke them to do their utmost for their own preservation, I would not pretend to say, as weak as they are. But while they are treated as members of one body and allowed their natural rights, it would be the height of madness for them to propose an independency, were they ever so strong."

Evans must have had a sharp eye for topography, as his geographical descriptions are still good enough to quote, and are indeed much better than many accounts of later date. He recognizes the fall line—'this rief of rocks, over which all the rivers fall.' The great Appalachian valley is held to be "the most considerable quantity of valuable land that the English are possest of; and runs through New Jersey, Pensilvania, Mariland and Virginia. It has yet obtained no general name, but may properly enough be called Piemont, from its situation." Of the Alleghenies, he says: "The Endless mountains * * * come next in order. They are not confusedly scattered and in lofty peaks overtopping one another, but stretch in long uniform ridges scarce half a mile perpendicular in any place above the intermediate vallies. * * * The mountains are almost all so many ridges with even tops and nearly of a height. To look from these hills into the lands is but, as it were, into an ocean of woods, swelled and deprest here and there by little inequalities, not to be distinguished one part from another any more than the waves of the real ocean."

Can any of the readers of Science give me a clue by which to reach some of the descendants of this early American geographer.

W. M. Davis.

Harvard University.

* At present it is far from being proved. Cf. Professor Cockerell's review of Romanes in this Journal, April 29, 1898.

MRS. PIPER, 'THE MEDIUM.'

To the Editor of Science: Your reference to my name in the editorial note in Science for April 15th, entitled 'Mrs. Piper, the Me-

dium,' justifies me in making some remarks of my own in comment on your remarks upon Mr. Hodgson's report of her case. Any hearing for such phenomena is so hard to get from scientific readers that one who believes them worthy of careful study is in duty bound to resent such contemptuous public notice of them in high quarters as would still further encourage the fashion of their neglect.

I say any hearing; I don't say any fair hearing. Still less do I speak of fair treatment in the broad meaning of the term. The scientific mind is by the pressure of professional opinion painfully drilled to fairness and logic in discussing orthodox phenomena. But in such mere matters of superstition as a medium's trances it feels so confident of impunity and indulgence whatever it may say, provided it be only contemptuous enough, that it fairly revels in the untrained barbarians' arsenal of logical weapons, including all the various sophisms enumerated in the books.

Your own comments seem to me an excellent illustration of this fact. If one wishes to refute a man who asserts that some A's are B's, the ordinary rule of logic is that one must not show that some *other* A's are *not* B's—one must show him either that those first A's themselves are not B's, or else that no A possibly can be a B. Now Mr. Hodgson comes forward asserting that many of Mrs. Piper's trances show supernatural knowledge. You thereupon pick out from his report five instances in which they showed nothing of the kind. You thereupon wittily remark, 'We have piped into you and ye have not danced,' and you sign your name with an air of finality, as if nothing more in the way of refutation were needful and as if what earlier in the article you call 'the trivial character of the evidence * * * * taken under the wing of the Society' were now sufficiently displayed.

If, my dear sir, you were teaching Logic to a class of students, should you, or should you not, consider this a good instance by which to illustrate the style of reasoning termed 'irrelevant conclusion,' or *ignoratio elenchi*, in the chapter on fallacies? I myself think it an extraordinarily perfect instance.

And what name should you assign to the fallacy by which you quote one of those five sitters as saying that he himself got nothing from the medium 'but a few preposterous compliments,' whilst you leave unquoted the larger part of his report, relating the inexplicable knowledge which the medium showed of the family affairs of his wife, who accompanied him to the sitting? I am not sure that the logic books contain any technical name for the fallacy here, but in legal language it is sometimes called *suppressio veri*, sometimes something still less polite. At any rate, you will admit on reflection that to use the conclusion of that sitter's report alone, as you did, was to influence your readers' minds in an unfair way.

I am sure that you have committed these fallacies with the best of scientific consciences. They are fallacies into which, of course, you would have been in no possible danger of falling in any other sort of matter than this. In our dealings with the insane the usual moral rules don't apply. Mediums are scientific outlaws, and their defendants are quasi-insane. Any stick is good enough to beat dogs of that stripe with. So in perfect innocence you permitted yourself the liberties I point out.

Please observe that I am saying nothing of the merits of the *case*, but only of the merits of your forms of controversy which, alas, are typical. The case surely deserves opposition more powerful from the logical point of view than your remarks; and I beg such readers of SCIENCE as care to form a reasonable opinion to seek the materials for it in the Proceedings of the Society for Psychical Research, Part XXXIII. (where they will find a candid report based on 500 sittings since the last report was made), rather than in the five little negative instances which you so triumphantly cull out and quote.

Truly yours,

WILLIAM JAMES.

MY note in SCIENCE was not 'editorial,' but was placed in that department of the JOURNAL for which editors take the least responsibility. I gave my individual opinion, Professor James gives his, and I fear that our disagreement is hopeless. I could not quote the 600 pages compiled by Dr. Hodgson, but I gave the concluding sentences written by *all* the men of

science whose séances were reported. Professor James blames me for not quoting the knowledge that the medium showed of the family affairs of Professor Shaler's wife, but Professor Shaler himself says, "I am * * * absolutely uninterested in it for the reason that I don't see how I can exclude the hypothesis of fraud." I wrote the note with reluctance and only because I believe that the Society for Psychical Research is doing much to injure psychology. The authority of Professor James is such that he involves other students of psychology in his opinions unless they protest. We all acknowledge his leadership, but we cannot follow him into the quagmires.

J. McKEEN CATTELL.

SCIENTIFIC LITERATURE.

Report of Naval Court of Inquiry upon the destruction of the United States battleship 'Maine,' in Havana harbor, February 15, 1898, together with the testimony taken before the Court. Washington, Government Printing Office, 1898. 8vo., pp. 293; illustrated by exhibits, drawings and photographs.

A message to Congress from the President of the United States, dated March 28th, accompanied the transmission of the report of the Court of Inquiry appointed to ascertain, if possible, the cause and the method of destruction of the U. S. S. 'Maine,' by an explosion, in the harbor of Havana, February 15, 1898. The message is short and merely restates in brief summary the essential conclusions of the Court; that the ship was destroyed by an explosion of a submarine mine, on the port side of the hull, well forward, and that no clew had been obtained to the train of circumstances leading to this great disaster, resulting in the death of two officers and two hundred and sixty-four of the crew, nor any evidence indicating who were the criminals guilty of this act of assassination.

The report, now before us, is a very long and intensely interesting paper, mainly given up to the simple stenographers' reproduction of the testimony of witnesses.

The testimony of the commanding officer of the shipand his staff is positive in declaring the ship to have been in good order in all respects, her crew in not only an excellent state of discipline, but also in the best of spirits and with absolutely no sign of discontent or of insubordination. Captain Sigsbee stated that 'A quieter, better-natured and apparently better satisfied crew I have never known on board any vessel in which I have served.' The executive officer testified to the maintenance of order and the compliance of all officers and the crew with the regulations which are considered essential to the morale and safety of a man-of-war, and gave positive evidence of the facts that there was no dangerous heating of coal-bunkers or other known source of danger within the vessel. Other witnesses testified to the character of the explosion, and still others, from other vessels in the harbor and from the shore, testified as to the appearance of the explosion from their various points of view. Divers gave testimony, in great detail, regarding the condition of the hull as found after the explosion, and the officers entrusted with that duty showed by means of carefully drawn sketches and diagrams the position of the ship and of its now separated main and bow sections, and gave expert testimony regarding their condition, as furnishing proof of the nature, origin and effects of the explosion, and especially as settling the question as to whether the explosion was exterior to the ship or within. This portion of the evidence is extensive and minute, and the Court was evidently determined to secure every scintilla of evidence obtainable bearing upon this vital question. The photographs and drawings appended to the report are reproductions of those presented in evidence.

According to the verdict of the court, the sworn testimony suffices to establish the following main points, to which its members subscribe under oath: The ship was on a friendly visit to Havana, as is customary among nations at peace; she was assigned a berth in the harbor by the regular harbor master; ship and crew were illustrating, at the time, a most creditable condition of excellence; there were no known interior sources of danger, and every usual precaution, and some unusual care, was taken in the internal menage of the vessel; danger from without was recognized and special watches set.

At 8 p. m., of February 15th, the usual and regular reports were made, indicating that all was well throughout the ship, and the crew and officers retired as usual. At 9:40 p. m. two explosions occurred; the first lifted the ship forward; the second produced most of the internal destruction; the protective and main decks were blown up, forward the smokestacks, and thrown aft and over to starboard, as is inferred, by the explosion of magazines. The keel and outer bottom plating of the ship is blown upward and inward, and now reaches, at one point, a height of over thirty feet above its original location, in the main line of the keel; this is considered to be due to the external explosion, and its evidence is taken as conclusive. This effect could only have been produced by the explosion of a mine, 'situated under the ship and on the port side.' The explosion of the magazines is considered to be the consequence of the primary explosion of the mine. No evidence was secured 'fixing the responsibility upon any person or persons.'

Many details of evidence are given which sustain the verdict of the Court; but the drawings themselves are perhaps the best proof that the ship herself, in her present position and condition, affords the best evidence, and most positive, regarding the source of the disaster. The bending upward of keel and bottom plating; the fact that all the lower positions of the ship, the lower and main decks, protective deck and frames, are forced upward and toward the starboard side; the complete breaking away of all the plating and the whole ship's side over a considerable area at the point at which the force of the explosion was felt; the distribution of the débris wholly toward the starboard side, and the non-existence of coal, or other material from the hold, on the port side of the ship; the location of the detached forward part of the vessel at right-angles with the original line of the keel; its separation and its relation to the uplifted keel—these and many other details appear in the evidence, and are shown by drawings made from measurement so fully as to afford, in the opinion of the experts constituting the Court and expert witnesses before it, sufficient proof to justify unqualified and positive statements regarding the nature of the explosion.

The report, happily, completely exonerates the officers and crew of the battleship; though, most unhappily, fails to fix the responsibility where it belongs, or to afford a clue to the authors of the catastrophe. This report, as a scientific discussion and a logical construction of proofs and conclusions, will always have more than historical interest, and it is very probable that the question: Who were the perpetrators of one of the most diabolical crimes of which history gives us an account? may forever remain unanswered.

R. H. THURSTON.

Birds of Village and Field: A Bird Book for Beginners. By FLORENCE A. MERRIAM. Boston and New York, Houghton, Mifflin & Company. The Riverside Press, Cambridge. 1898. Illustrated. 12mo. Pp. xlix+1–406. 28 half-tone plates and 220 cuts in text. Price, $2.00.

The ever-swelling stream of popular bird books is still further augmented by this attractive little volume which is possessed of a sparkle all its own as compared with several of its numerous competitors. The accuracy of the writer's statements and the breezy originality of her bits of bird biography commend her work to every bird lover be he scientifically or otherwise minded. The book is written for the otherwise minded, for the beginner, but as the Latin name, a few words of description and a mouthful of 'geographic distribution' precede each species mentioned, no one may justly complain that the scientific cravings of his nature are not stilled.

The introduction contains much about the economic value of birds to the farmer, and considerable stress is laid upon this matter elsewhere throughout the volume. It also contains a 'Field Color Key to adult spring males mentioned in this book,' and is followed by brief sketches of about one hundred and fifty common everyday species, such as one meets in eastern North America, including the Mississippi Valley. And, by the way, it seems to have been an oversight that no direct mention is made as to what section of the country is covered by the title. Following the sketches which make up the bulk of the volume is an

appendix containing a sample of the migration blank used by the U. S. Department of Agriculture; lists of migrants (with dates of arrival and departure) and winter birds at Washington, D. C., Portland, Conn., and St. Louis, Mo.; an 'Outline for Field Observations,' which is probably the most complete key as to the proper use to make of one's eyes in the field ever formulated; a list of the birds known to nest in Portland, Conn.; a list of books of reference; and a comprehensive index. The pages are profusely illustrated not only with half-tone plates and other figures of birds' heads, bills and feet, but also with figures of insects and plants to show the nature of the birds' food.

The book is remarkably free from errors, though I notice under Red-poll Warbler, at page 317, Illinois birds referred to the Eastern race and no notice at all taken of the Mississippi Valley race. Other criticisms resolve themselves chiefly into differences of opinion. Every book that deals with only part of the birds of a given locality and presents a key of male birds only and these in spring dress, without hint of rarer species that inconveniently pop up before even a beginner's eyes is necessarily a frail guide. It seems as if he ought to be warned of possibilities. He ought also to be warned not to take the 'law' of protective coloration (as cited at page 34, and elsewhere referred to) too seriously. There are numerous exceptions to it not as yet satisfactorily explained.

One feature of the book open to objection is the lack of arrangement of the species in any sort of order except that, as the writer confesses, 'the birds which readers are most likely to know and see are placed first, the rarer ones left until later.' This idea results in splitting up the Sparrows, the Vireos, the Woodpeckers and other groups so that some species are found in one part of the book and others, closely allied, in another, and after all we find such familiar birds as the Yellow Warbler, the Redstart, the Maryland Yellow-throat and the Oven-bird very close to the end, precedence being given to the Passenger Pigeon, the Pileated Woodpecker, the Snowy Owl and others less distinctly rare.

The press-work is excellent; the plates range from good to bad, one of the best being that of the Long-billed Marsh Wren at page 202; and the figures serve a useful purpose. The beginner might complain that the two sizes of cuts given in many cases (there are three different sizes of the cut of the Belted Kingfisher, pp. xix, 158 and 165) tend to confuse his ideas of relative size, but he should remember the illustrated alphabet of his first primer at school where 'cat' and 'horse' cover equal areas.

It would improve the volume if the comparisons and supplemental keys were set off from the species they follow. For instance, the sketch of Bachman's Sparrow at p. 242 apparently occupies several pages that are in no wise part of its biography.

Aside from these somewhat trivial imperfections there is little to criticise, and it is only a matter of regret that the biographies are not twice as long.

J. D., Jr.

SCIENTIFIC JOURNALS.

The *American Journal of Science* for May opens with an article by Mr. T. A. Jaggar, Jr., on 'Some Conditions affecting Geyser Eruptions.' There are other papers on geological and mineralogical topics, as follows: 'Determination of Plagioclase Feldspars in Rock Sections:' by Dr. G. F. Becker. 'Some Lava Flows of the Western Slope of the Sierra Nevada, California:' by Mr. F. L. Ransome. 'Krennerite, from Cripple Creek, Colorado:' by Professor A. H. Chester. 'Some New Jurassic Vertebrates from Wyoming:' by Professor W. C. Knight. 'Estimation of Manganese Separated as the Carbonate:' by Mr. M. Austin. The number also contains two important physical papers: 'Properties of Seasoned Magnets of Self-Hardening Steel:' by Professor B. O. Peirce; and 'Curious Inversion in the Wave Mechanism of the Electromagnetic Theory of Light:' by Professor C. Barus.

Terrestrial Magnetism for March opens with an illustrated article in French, giving a description of the new magnetic observatory at Parc Saint-Maur, near Paris, by M. Moureaux, the director of the observatory. As the old observ-

atory constructed in 1882, primarily for the purpose of taking part in the international scheme of observations of that period, was not especially adapted to the modern requirements of a magnetic observatory, a new building was erected on the same grounds and the old one set aside for special observations. A complete fifteen-year series has been obtained at the old observatory, and the registrations at the new observatory began on January 1st of this year. Unfortunately, at the very outset of its new career the observatory is menaced by the possibility of disturbance from electric cars which would pass 1,600 meters south of the observatory. Professor Cleveland Abbe contributes the first installment of an interesting article on 'The Attitude of the Aurora above the Earth's Surface.' His object is to collect some of the numerous observations, calculations and opinions bearing on the nature and the attitude of the auroral light. He therefore proceeds, in the present contribution, to give a chronological summary, beginning with Halley and ending with Young. Professor Schuster follows, writing: 'On the Investigation of Hidden Periodicities with Application to a supposed 26-Day Period of Meteorological Phenomena.' He undertakes to introduce scientific precision into the treatment of problems which involve hidden periodicities, and to apply the theory of probability in such a way that it may be possible to assign a definite number for the probability that the effects found by means of the usual methods are real, and not due to accident. An extract from Professor Rücker's recent lecture on 'Recent Researches on Terrestrial Magnetism,' exhibiting the intimate relationship between the geological and the magnetic constitution of Great Britain is next given. Mr. Putnam contributes an interesting 'Note in Regard to Magnetic Disturbances on St. George Island, Bering sea.' In a 'Letter to Editor,' W. van Bemmelen gives an account of his recent researches respecting old magnetic observations.

WE have received the number of the *Journal of the Institute of Jamaica* issued on the 28th of March. It contains an account of the meetings of the Institute—which includes literature and art as well as science—and a number of papers. Among these may be mentioned a life history of some Jamaica Hesperiidæ, by Mr. E. Stuart Pantin, which was awarded the Institute's prize for the most valuable research on the natural history of Jamaica. There is also a paper on the Actinaria of Jamaica, by Mr. J. E. Duerden, the curator of the museum of the Institute, who also contributes several science notes.

THE May *Century* contains several articles of scientific interest. It appears in a special cover, printed in gold and colors, after a design by Fernand Lungren, representing the great mesa of Katzímo. This is apropos of an article in the number by Mr. F. W. Hodge, of the Ethnological Bureau, describing his recent 'Ascent of the Enchanted Mesa.' Mr. Hodge gives the evidence he has discovered, already reported in this JOURNAL, for the truth of the old Ancoma tradition that the mesa was once the site of a Pueblo settlement. The article is illustrated from photographs and with pictures by Mr. Lungren, who also contributes a supplement article, 'Notes on Old Mesa Life.' Professor Trowbridge contributes an important article, illustrated from photographs, on the X-rays. Professor Louis Boutan, of the Sorbonne, gives an account of his successful experiments in 'Submarine Photography,' and there are reproductions of several photographs taken under the sea at various depths, including one made by artificial light. An article by Mr. Oscar Chrisman on 'The Secret Language of Childhood' is based on contributions made by him him to SCIENCE. Partly scientific in character are also the articles by Professor B. I. Wheeler on 'The Great Pyramids of Egypt,' and by Mr. F. B. Locke on 'Railway Crossings in Europe and America.'

THE *Annales d'électrobiologie d'électrothérapie et d'electrodiagnostic* is a new bi-monthly journal published since the beginning of the present year by M. Alcan, Paris, with Dr. E. Dourner, as editor-in-chief and an editorial committee including MM. d'Arsonwal, Tripier, Apostoli and Oudin. The two issues that have appeared extend the first volume to 286 pages, and contain numerous articles and full bibliographies. The subscription price for America is 28 fr.

THE issue of the New York *Independent* for

the present week is an African number. It contains a political-physical map of Africa printed in colors and numerous contributions by well-known writers, including Mr. Henry M. Stanley, Dr. Scott Keltie and others.

THE May *Educational Review*, concluding the fifteenth volume, contains the following papers prepared for the Harvard Teachers' Association: The election of studies in secondary schools, five articles, as follows: 1. 'Its Effect upon the Colleges:' by Nathaniel S. Shaler. 2. 'Its Effect upon the Community:' by Samuel Thurber. 3. 'A Negative View:' by John Tetlow. 4 and 5. 'Affirmative Views:' by Charles W. Eliot and George H. Martin. 'The School Grade a Fiction:' by Wilbur S. Jackman; and 'Knowledge Through Association:' by T. L. Bolton and Ellen M. Haskell.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON—291ST. MEETING, SATURDAY, APRIL 9.

MR. VERNON BAILEY described the manner in which beavers fell trees, saying that they did not gnaw squarely across, but made two cuts a short distance apart vertically and pried out a chip between them. The result was a V-shaped cut very similar in appearance to that made by a wood cutter.

Professor O. P. Hay made some 'Observations on the genus of Cretaceous Fishes, called by Professor Cope *Portheus*,' discussing the osteology of the genus at some length and particularly the skull, shoulder girdle and vertebral column. He said that in many respects it resembled the Tarpon of our Southern coasts, although possessing widely different teeth, and undoubtedly belonged to the Isospondyli. The conclusion was reached that Cope's *Portheus* is identical with the earlier described genus *Xiphactinas* of Leidy. (Since the paper was read the author has learned that Professor Williston has reached the same conclusion.)

Mr. W. H. Osgood gave some 'Notes on the Natural History of the Farallon Islands,' dwelling particularly on the birds and illustrating his remarks with lantern slides. Mr. William Palmer presented a paper on 'A Phase of Feather Re-pigmentation,' briefly reviewing the discussion regarding this mooted question, stating that much of the discrepancy between the statements of the advocates and opponents of the subject was probably due to the geographical conditions under which their birds had been obtained. The theory was advanced that migration arrested the moult of birds, the drain upon their strength made by protracted flight preventing the growth of the new feathers and the shedding of the old.

F. A. LUCAS,
Secretary.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 276th regular meeting of the Society was held on Tuesday evening, April 5, 1898. Professor Otis T. Mason read a paper on 'Egypt in America.' He called attention to the early and insidious intrusion of the Iron Age into America everywhere, through the blonde Teuton, the dark-eyed Kelt and the melanchroic Spaniards and Portuguese. This time he confined the argument to the way in which much of the primitive life of Arabia, Palestine, Egypt and Northern Africa found its way to Latin America. Dr. Brinton, he said, had just emphasized the vast importance of North Africa and the Hamite (Khamite) in early civilization. Keane also had dwelt on this same subject in his late work, and Ripley was quoted as saying, "Beyond the Pyrenees begins Africa." The first settlers of Spain were Hamites, and they formed the folk of the peninsula during Keltic and Roman occupation. Phœnicia strengthened the bond with the mother race. Carthage went to Spain to claim her own, and for seven hundred years and more (711–1492) all the Semite-Hamite elements of the Moorish occupation were added to the old. It was this that furnished the folk life that came to middle America and easily and early affiliated itself with the natives. This folk life insidiously grows over the old, genuine, aboriginal culture and attracts the eye of the traveler who may have sojourned also in North Africa, Egypt or Palestine. By the trained eye it is easily detected and eliminated. For three thousand years the Khamites accultured Spain. In the

operative classes of all Spanish and Portuguese expeditions they crowded into the western hemisphere, and that is one way in which Egypt came to America. Discussed by Professor W J McGee.

Dr. Thomas Wilson read a paper entitled 'The Mysterious Chamber and the Magic Key.'

Mr. Isaac P. Noyes read a paper on 'The Peruvian Mummy.'

J. H. McCORMICK,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 483d meeting of the Society was held at the Cosmos Club at 8 p. m. on April 16th. The first paper of the evening was by Mr. C. C. Yates on 'Personal Equation in Estimating Tenths.' The author stated that attention was first called to this equation by Pierce, in the Coast Survey Report for 1854. It was defined as a persistent deviation from the law of probability applied to the distribution of purely accidental estimates.

Mr. Yates illustrated this by diagrams representing equations obtained from readings of chronometers, micrometers, thermometers, levels, etc., involving, in all, 38,499 estimated tenths.

His conclusions from the study were that:

1. The personal equation in estimating makes its appearance in every species of observations involving an estimate.

2. It is the result of a defective habit or condition of the observer.

3. It can be more or less modified when attention has been called to it, except in its elements due to fixed conditions, such as astigmatism of the eye.

The second paper was by Mr. G. W. Littlehales on 'The Progress of Trans-oceanic Navigation in the 18th and 19th Centuries.'

The address described the extent of the influence of scientific work in the material affairs of mankind by pointing out what the investigators in astronomy, meteorology, mathematics, mechanics and physics have done during the last two centuries toward the improvement of navigation and the advancement of commerce on the sea.

Perhaps the striking progress in trans-oceanic navigation which the paper portrayed may best be reflected by these two sentences taken respectively from the former and the latter part:

"Driven by the variable winds—which were the sole motor of ocean commerce and of the fleets of nations in that age—and generally without other implements for navigation than the compass, log and line, it became the first duty of every captain to keep his ship in the company of others having the same general destination and thus to regulate his speed to the progress of the dullest sailor and the most indolent master in the fleet."

"A modern steamship works against time. Her paying qualities depend upon the celerity with which she can get from port to port, and her captain—generally disregarding the wind and weather upon which all depended in the old days, but mindful of the perils of navigation—chooses that course which offers the least number of miles of travel and upon which, if practicable, he can head his ship for the port of destination as if it were in sight throughout the voyage."

The third paper was read by Mr. W. H. Dall, in the absence of the author, Mr. Signe Rink. This interesting communication was 'On the Origin of the Eskimo Name for the White Man.'

E. D. PRESTON,
Secretary.

NEW YORK ACADEMY OF SCIENCES—SECTION OF BIOLOGY.

THE annual election of sectional officers resulted in the re-election of Professor E. B. Wilson and Mr. G. N. Calkins to the offices of Chairman and Secretary respectively.

Dr. O. C. Strong reported on a new point on the Innervation of the Lateral Line Organs, and the substance of his paper was as follows:

The view as to the innervation of the organs of the lateral line system which is upheld by the most recent investigations is that these organs are exclusively innervated by certain special roots, having a common center in the medulla. Certain exceptions have been recorded, however, which apparently militate against this view. One of these exceptions is the innervation of a certain canal organ by a

branch of the glossopharyngeus and thus apparently not by a lateral line nerve proper. This anomaly has been described in certain teleosts, ganoids and elasmobranchs.

In studying serial sections through the head of a young dog-fish (*Squalus acanthias*) a condition was found which not only explained this apparent exception, but converted it into an additional support for the specific character of the lateral line nerve roots. The lateral line nerve to the trunk and the glossopharyngeus emerge from the medulla in about the same transverse plane, the former being dorsal to the latter. Close to their exit from the medulla a small intracranial bundle of fibres becomes detached from the lateral line root and fuses with the glossopharyngeus. This bundle could be still followed as a component of the latter, however, owing to the greater caliber of its fibres. When the glossopharyngeus emerges from the auditory capsule the bundle in question soon becomes detached and could be traced to a canal organ. Undoubtedly the fibres, described by Kingsbury, which the glossopharyngeus in Amia receives from the root of the lateral line nerve, would be found to have a similar destination if traced in this way—as indeed Kingsbury himself has suggested.

H. E. Crampton,
Sec. pro. tem.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis on April 18, 1898, eighteen persons present, Mr. Carl Kinsley read a paper on 'Series Dynamo Electric Machines.' He showed, by the results of tests of machines, that the relations between electromotive force, current and speed can be represented by a surface. This is easily done, since for widely different currents, and for both dynamos and motors, the total induced electromotive force is strictly proportional to the speed when the current is constant. He stated that Frölich's empirical equation can be used to represent large portions of this surface, as suggested by Professor F. E. Nipher.

It was stated that the way in which a series motor will operate from a series generator can be predetermined; and, for cases reported, it was shown that computed results throughout the complete range of working conditions gave an average agreement with observed results to within 0.05 per cent. The method explained in the paper enables an engineer to design such a power transmission circuit accurately from shop tests of the machinery, and to operate the series motor at constant speed under all loads.

It was shown that the resistance of the generator does not vary with the speed. This makes it possible to use a small series generator as a speed indicator and so obtain instantaneous values of engine speeds from the volt-meter or ammeter readings, if the resistance of the outside circuit is kept constant. The practicability of this methed of determining engine speeds was fully shown by the results reported in the paper.

Professor J. H. Kinealy made some informal remarks on the ventilation of schools, and by means of a number of stereopticon views showed the different methods adopted for supplying the air required to the different rooms of schoolhouses.

Four new members were elected.

William Trelease,
Recording Secretary.

NEW BOOKS.

Il Codice Atlantico. Leonardo Da Vinci. Milan, Ulrico Hoepli; New York, Gustav Stechert.

Studies of Good and Evil. Josiah Royce. New York, D. Appleton & Co. 1898. Pp. xv+384. $1.50.

Alternate Currents in Practice. Francis J. Moffett. London, Whittaker & Co.; New York, The Macmillan Company. 1898. Pp. ix + 376. $5.

Lectures on the Geometry of Position. Theodore Reyl; translated by T. F. Holgate. New York, The Macmillan Company. 1898. Part I. Pp. xix + 248. $2.25.

A Treatise on Magnetism and Electricity. Andrew Gray. London and New York, The Macmillan Co. 1898. Pp. xv + 947. $4.50.

The Development of the Child. Matthew Oppenheim. New York and London, The Macmillan Co. 1898. Pp. 296. $1.25.

SCIENCE

FRIDAY, MAY 13, 1898.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE NEW YORK ACADEMY OF SCIENCES.

ADDRESS BY THE PRESIDENT, PROFESSOR HENRY F. OSBORN, AT THE FIFTH ANNUAL RECEPTION.

Members of the Academy and of the Scientific Alliance: Welcome to the Fifth Annual Reception!

AN Academy of Science stands as a clearing house for scientific ideas; for the encouragement, diffusion and interchange of methods and principles between all branches. The elasticity of our own Academy is well illustrated in this fifth annual exhibition of the progress of science. Thanks to the energy of our Secretary, Professor Dodge; of the Chairmen of the many different sections and the cooperation of institutions in all parts of the country, it appears to cover a broader field than ever before. Here you can obtain glimpses of the work in many lines progressing at Harvard, the Johns Hopkins, Princeton, the U. S. Coast Survey, Chicago, the Troy Polytechnic, the Allegheny Observatory, besides our own City College, University of New York, Columbia University and, not least, this great Museum.

Methods.—Here, too, the methods and instruments of research, as well as the results of work in the most diverse fields of scientific enterprise, are brought together and stimulate us by their very contrast. Our inventiveness is as notable in the beautifully delicate instruments for studying

the human senses displayed by the psychologists as in the apparatus developed by our astronomers and physicists. Beside the newest technique of pure research in the physical and biological sciences, you will find beautiful and diverse methods applied to the arts, to photography, to the manufacture of exquisite glass vases, as well as to the more useful clays from all parts of Europe.

Explorations.—True to the Monroe Doctrine, we are no longer allowing France, Germany or any other country to preoccupy our proper scientific territory, and you will observe proofs of especial activity along the noble western coast of the Americas from Cape Horn to Point Barrow, Alaska. From the photographs of Arequipa, Peru, the highest astronomical station in the world, the mosses of northern Bolivia, the Indians of Mexico, we have invaded British territory and are making the study of the North Pacific and the zoology of the Pacific Coast from Puget Sound to Alaska our own. We are also invading other countries by expeditions of various kinds, and our geologists and mineralogists draw their exhibitions from every part of the world, from Tasmania to Finland.

Diversity of Subjects.—The subjects treated in this exhibition are as widely separated as these geographical areas; in adjoining alcoves you will find the brains of New Guinea natives and the moth Siamese Twins. Across the aisle, in the field of electricity, signalling without wires is in process, widely in contrast with the concentrated polar cold of the liquid air in the main hall. The monster Camarasaur, at least ten millon years old, from the base of the Cretaceous, puts a Pickwickian interpretation upon the words 'old' and 'rare' as applied to the manuscripts in the department of philology.

Progress.—Scientific work day by day appears to drag. It is only when an interval of a few months passes and we have taken stock of things that we realize our immense progress. We are especially encouraged for the future by the generous gifts which are pouring into the service of science in this city. Only a week ago a gentlemen agreed to fit out an expedition to the west coast of Africa. Fortunate is the country where men of brains are drawn into the pursuit of science, and men of appreciation and wealth supply the sinews of scientific warfare. Pure research is a luxury, for it brings no immediate return, but as an investment it finally repays a city or a country a hundred or a thousand fold.

At our annual exhibition last year we signalized electricity as the especial subject of scientific progress in the person of Mr. Nikola Tesla. This year we believe that astronomy deserves the place of honor. American astronomy, reaping, as it does, the combined advantages of our mathematical genius and natural inventiveness, of our wonderfully clear sky, and the support of generous wealth, certainly occupies a commanding position. We, therefore, take pleasure in introducing Professor George E. Hale, who will tell you of the great Yerkes Observatory and the especial merits of large telescopes.

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*THE FUNCTION OF LARGE TELESCOPES.**

The annual exhibitions of the New York Academy of Sciences afford excellent opportunities for studying the progress of science. The photographs and specimens gathered here to-night are substantial evidence that in no department of research have investigators been idle during the last twelfthmonth. So true is this that to sketch the year's advances in even a single field would consume more time than is allotted to the annual lecture. It therefore seemed to me wise,

* An address given at the Fifth Annual Reception of the New York Academy of Sciences.

in responding to the courteous invitation with which I was honored by the Council, to select a subject involving certain details of astronomical progress, without attempting to undertake the inviting task of portraying the rapid advances which make up the recent history of the science. I accordingly invite your attention to some considerations regarding the function of great telescopes.

On the 21st of last October, in the presence of a large company of guests, the Yerkes Observatory was dedicated to scientific investigation. The exercises were held under the great dome of the Observatory, beneath the 40-inch telescope. Is there reason to suppose that some in the audience, particularly those having no great familiarity with astronomical instruments, were inclined, in the course of the reflections to which the occasion may have given rise, to attribute to the great mass of steel and optical glass rising far above their heads some extraordinary and perhaps almost supernatural power of penetrating the mysteries of the universe? It is not at all unlikely that this was the case. For there apparently exists in the public mind a tendency to regard astronomical research with a feeling of awe which is not accorded to other branches of science. In its power of searching out mysterious phenomena in the infinite regions of space a great telescope seems to stand alone among the appliances of the investigator. Partly because of this special veneration for its principal instrument, and perhaps still more on account of the boundless opportunity for speculation regarding the origin and nature of the universe, astronomy appears to command the interest of a great portion of the human race. No doubt there are also historical reasons for the special attraction which the subject seems to exercise. In the more prosperous days of the countries bordering on the Mediterranean astrology played an important rôle, and mediæval history illustrates most clearly the ascendency which the fancies of the astrologers had acquired over even cultivated minds. So strong was the tendency of the times that even so able an astronomer as Tycho Brahe was wont to cast horoscopes, in the significance of which he firmly believed. He concluded that the new star of 1572 prognosticated great changes in the world. Similarity to the ruddy planet Mars pointed to wars, pestilence, venomous snakes and general destruction, and its resemblance to Venus, Jupiter and Saturn at other times foretold temporary pleasant influences, followed by death and famine.* Thus the heavenly bodies in their courses were supposed to exercise evil or benign influences upon the human race, and the apparition of a great comet or a new star gave rise to endless speculations regarding the fate to which the inhabitants of the Earth were shortly to be exposed. Even in our own day it cannot be said that we have altogether escaped from the entangling meshes of the astrological net. With that strong desire to be humbugged which Dr. Bolton has so well illustrated in his recent paper in SCIENCE on Iatro-Chemistry, a portion of the general public seems to devote itself with enthusiasm to the encouragement of charlatans, whether they deal with alchemy, with medicine or with astrology. So it is that astrologers flourish to-day, and continue to derive profit from their philanthropic desire to reveal the future to inquiring minds.

The interest of cultivated persons in astronomy and in the possibilities of great telescopes is by no means to be compared with the blind groping of less developed intellects after the mysteries of astrology. But if we must regard the large circulation of certain newspapers as any index to the popularity of their contents, we are forced to admit that their readers may comprise a

* See Dreyer's *Tycho Brahe*, p. 50.

class of persons whose admiration for the science is at least distantly related to the love for the sensational which dominates the followers of modern seers and sooth-sayers. Great telescopes are no sooner erected than these papers begin to demand extraordinary revelations of celestial wonders. The astronomer, quietly pursuing his investigations in the observatory, is from time to time startled by imperative demands to introduce a waiting and anxious public to the equally expectant inhabitants of Mars. Minute particulars as to the appearance, strength, stature and habits of these hypothetical beings, whose existence is freely taken for granted, are expected to be the results of a few moments' observation with the great telescope. When the astronomer mildly protests that his observations are likely to afford little or no material for discussions of such topics, he is at least supposed to so cultivate his imaginative powers that he shall be able to supplement his unsatisfactory observations by intuitive perception of things which are beyond his telescope's unaided appreciation. And it must be admitted that this demand on the part of some portion of the public press, while in one sense only a certain phase of the almost universal desire for sensation, has not lacked encouragement from men who are generally regarded as serious astronomers, intent on arriving at the truth by the methods of exact science. To such is due a widespread belief in the inhabitants of Mars, who in the popular novels of the day have not even been content with life upon their own planet, but, in accordance with the astrological significance of the god of war, have come to bring destruction upon the inhabitants of the Earth. However entertaining we may find the doings of these strange individuals, whether at home or abroad, we must not make the mistake of classing the works which describe them with the literature of science, but rather accord them their proper place among the pleasant romances which we owe to men of letters.

I cannot better illustrate one phase of this pseudo science than by a reference to the celebrated 'Moon Hoax,' which caused such a stir at the time of its appearance. When Sir John Herschel sailed for the Cape of Good Hope in 1833 he little imagined what marvelous discoveries lay before him. It is true that he was provided with a great reflecting telescope of twenty feet focal length, which was to be used upon the previously unexplored regions of the southern heavens, and it could not have been difficult for him to form some conception of the valuable additions he was certain to make to astronomical knowledge. But the imagination of others by far outran the more prosaic course of his own mind, and results were obtained for him which unfortunately his telescope never served to show. Many who are present are no doubt familiar with a pamphlet entitled 'Great Astronomical Discoveries lately made by Sir John Herschel, LL.D., F.R.S., etc., at the Cape of Good Hope,' which was 'first published in the New York *Sun*, from the supplement to the *Edinburgh Journal of Science.*' In the truly entertaining pages of this ingenious narrative we find an example which certain reporters of our own day seem to have taken to heart. Let me quote a paragraph of nonsense which is so amusingly conceived and proved so effective when published that one is almost ready to forgive the perpetrator. After a lucid historical discourse on the great telescopes which had been made by Sir William Herschel and other previous investigators, followed by an impassioned paragraph which may well be considered to approach in eloquence the most fervid astronomical literature of our own day, our author treats us to an account of a conversational discussion between Sir John Herschel and Sir David Brewster, which began with a consideration of certain

suggested improvements in reflecting telescopes, and soon directed itself "to that all-invincible enemy, the paucity of light in powerful magnifiers. After a few moments silent thought, Sir John diffidently inquired whether it would not be possible to effect *a transfusion of artificial light through the focal object of vision!* Sir David, somewhat startled at the originality of the idea, paused awhile, and then hesitatingly referred to the refrangibility of rays and the angle of incidence. Sir John, grown more confident, adduced the example of the Newtonian reflector, in which the refrangibility was corrected by the second speculum, and the angle of incidence restored by the third. 'And,' continued he, 'why cannot the illuminated microscope, say the hydro-oxygen, be applied to render distinct, and, if necessary, even to magnify the focal object?' Sir David sprung from his chair in an ecstacy of conviction, and, leaping half-way to the ceiling, exclaimed, 'Thou art the man!' Each philosopher anticipated the other in presenting the prompt illustration that if the rays of the hydro-oxygen microscope, passed through a drop of water containing the larvæ of a gnat and other objects invisible to the naked eye, rendered them not only keenly distinct, but firmly magnified to dimensions of many feet; so could the same artificial light, passed through the faintest focal object of a telescope, both distinctify (to coin a new word for an extraordinary occasion) and magnify its feeblest component members."

Here, indeed, was a discovery fit to startle the world; and one cannot be surprised that, after so extraordinary an advance, Sir John Herschel should have immediately arranged for the construction of an object-glass 24 feet in diameter. Contributions towards this important work were received from many royal personages, culminating in a gift by his Majesty the King of some seventy thousand pounds, which was considered ample to meet all expenses. Many difficulties were encountered in casting the great object-glass, which was composed of "an amalgamation of two parts of the best crown with one of flint glass, the use of which in separate lenses constituted the great achromatick discovery of Dolland." Notwithstanding the prodigous size of this enormous lens, which weighed 14,826 pounds after being polished, and whose estimated magnifying power was 42,000 times, Sir John was not satisfied. Not content with the mere illuminating power of the hydro-oxygen microscope, "he calculated largely upon the almost illimitable applicability of this instrument as a second magnifier which would supersede the use and infinitely transcend the powers of the highest magnifiers and reflecting telescopes." Indeed, so certain was he of the successful application of this idea that he counted upon "his ultimate ability to study even the entomology of the Moon in case she contained insects upon her surface."

It would be interesting, if time permitted, to consider with our inspired author the various further details in the construction of a telescope which was the first to render visible the inhabitants of the Moon. It may well be imagined with what breathless interest the report of Sir John's extraordinary discoveries, which constitutes the body of our pamphlet, was received by a willing public. "It was about half past nine o'clock on the night of the tenth, the Moon having then advanced within four days of her mean libration, that the astronomer adjusted his instruments for the inspection of her eastern limb. The whole immense power of his telescope was applied, and to its focal image about one-half of the power of his microscope. On removing the screen of the latter, the field of view was covered throughout its entire area with a beautiful distinct and even vivid representation of *basaltic*

rock." For further details regarding the rock and the lunar flora which covered it, reference must be made to the original pamphlet. There, too, can be found descriptions of deep blue oceans, breaking in large billows upon beaches of brilliant white sand, girt with wild castellated rocks. Passing inland wide tracts of country of apparently volcanic character were rapidly passed over, soon bringing to the observer's eye lofty chains of slender pyramids of faint lilac hue, which, when examined with the highest power of the instrument, were seen to be monstrous amethysts reaching to the height of sixty to ninety feet, and glowing in the intense light of the Sun. It must not be supposed that such delightful regions were devoid of life. Birds and beasts of strange and uncouth form were soon brought to view, and, last and greatest marvel of all, the observer was permitted to behold beings of manlike form. Although not seen engaged in any work of industry or art, they were evidently of a high order of intelligence, and to them was doubtless due a magnificent temple, built of polished sapphire, with roof of yellow gold. The observer did not at the moment pause to search out the mystery symbolized in the unique architectural details, for he was then "more desirous of collecting the greatest possible number of new facts than of indulging in speculative theories, however seductive to the imagination."

But we have already dwelt too long upon this product of enterprising journalism, which poor Sir John was too far away to be able to contradict. It is enough to remark that the author accomplished his immediate purpose, and moreover bequeathed to future generations a classic in this special field of literature.

The astronomer of to-day is unfortunately exposed to similar misrepresentation. On account of the fact that it is a little larger than any other refractor, the Yerkes telescope is particularly open to attack. Take, for example, these sentences from a newspaper which would not ordinarily be considered as one of the sensational class: "After Professor Barnard had swept the sky in the region of the nebulæ he pointed the instrument toward a region located to the astronomer in Pos. 312 degrees; Dist. 53 minutes. He swung the giant tube toward the region and the first discovery at the Yerkes Observatory was registered on the dial near the dome." This is merely the newspaper's own peculiar way of paraphrasing a simple statement in the *Astrophysical Journal* regarding the detection of a faint star near Vega. A persistent search by all the members of the staff has not yet brought to light the mysterious 'dial near the dome,' with its precious record of discovery. It seems probable that the same dial must have treasured up the remarkable observations of the Moon, which the Associated Press thought worthy of transmission to Europe, though they originated in a reporter's fertile brain, and still remain unknown to the telescope to which they were ascribed. An influential newspaper selected these latter observations as the text of an editorial setting forth the marvelous benefits the Yerkes telescope is destined to confer upon mankind.

It may be added that the great telescope of the 'Moon Hoax' is hardly more extravagant in conception than certain schemes which have been proposed in all seriousness within the past year. One of these inventors, whose familiarity with the difficulties of telescopic observation is certainly surpassed by his optimism, remarks: "I think the limit (of magnification) will be due to the shaking of the instrument caused by the trembling of the earth and of the clockwork mechanism which moves the telescope. Under these high magnifications extremely minute vibrations are so much magnified that a small object like that of a house

upon the surface of Mars would dart in and out of the field of vision so as to prevent its being photographed." And this he believes to be the only obstacle (though fortunately it is to be overcome) which can interfere with his studies of Martian architecture.

So far we have considered only what great telescopes *cannot* accomplish, and were I not to pass rapidly on to some positive statements of another character, I might be supposed to believe that they have no reason for existence, or at best are no better than small ones. But I shall endeavor to show that exactly the contrary is true; that while large telescopes do not possess the extraordinary powers conferred upon them by fertile imaginations, they nevertheless play a most important part in scientific research, and render possible many investigations which are altogether beyond the reach of smaller instruments. It seems the more necessary to dwell upon this point, for only a few years ago there appeared in print an article entitled 'Do Large Telescopes Pay?' which was evidently not written by one of those to whom reference has just been made, but by one of another class, whose known acquaintance with astronomical work would tend to give his opinion considerable weight with many intelligent readers. In discussing the subject it was seriously asked whether the great investments of money which had been made in the giant instruments of the latter half of the nineteenth century had been attended by commensurate advances in astronomical knowledge. The question is certainly one that deserves serious consideration, for it would surely be poor policy to erect great telescopes if they are no better than smaller and much cheaper ones. It is desirable, therefore, to point out, if I can, some of the elements of superiority of large instruments which seem to me to make them worth all that they cost and more.

Leaving aside reflecting telescopes, as most of the very costly instruments in use are refractors, it will be seen that our problem is, for the most part, a comparison of the properties of a large achromatic lens with those of a small one. To render the discussion more definite let us compare a 40-inch lens of 62 feet focus with a 10-inch lens of $15\frac{1}{2}$ feet focus. The large lens, then, has a diameter four times that of the small one, which means that its area is sixteen times as great. It will thus receive upon its surface from a given star sixteen times as much light, and all of this will be concentrated in the point-like image of the star, except that portion which is lost in transmission through the lens. On account of its greater thickness, the large lens transmits only about 65 per cent. of the visual rays that fall on it, while the small lens transmits about 77 per cent. But after allowance has been made for the loss due to both absorption and reflection it is found that the image of a given star produced by the large telescope will be nearly fourteen times as bright as that given by the small one. In this instance all of the light is concentrated in a point, but in the case of a planet or other extended object, on account of the fact that the focal length of the telescope increases as its aperture increases, the brightness of the image is no greater with the large glass than with the small one. The image is, however, four times as large, and this has a most important bearing upon certain classes of observations, particularly in photographic and spectroscopic work.

There remains still another peculiarity of the large lens as distinguished from the small one. On account of the nature of light, the power that a lens possesses of separating two luminous points which are so close together as to be seen as a single object by the unaided eye depends directly upon its aperture. Thus, if we consider a

double star, the two components of which are separated by a distance of 0″.5 of arc, it will be barely possible with a 10-inch telescope to resolve the star into two points of light just touching one another. If the members of the pair are closer than this they cannot be separated with a 10-inch glass, no matter what magnifying power is used. With a 40-inch telescope, on the other hand, it is not only a simple matter to separate stars 0″.5 apart, but it is even possible to distinguish as two points of light the components of a double star of only 0″.12 separation.

To sum up, then, we see that the principal advantages of a 40-inch object-glass as compared with one of 10 inches aperture are: first, its power of giving much brighter star images, and thus of rendering visible faint stars which cannot be seen with the smaller telescope; second, the fact that it gives at its focus an image of any object, other than a star, four times as large as the image given by a lens of one-fourth its aperture and focal length; and third, its capacity of rendering visible as separate objects the components of very close double stars or minute markings upon the surface of a planet or satellite. Mention should be made here of the fact that the large glass assuredly has some disadvantages as compared with the smaller one, particularly in that it requires better atmospheric conditions to bring out its full qualities. But I think it will be seen from what follows that these disadvantages are by no means sufficient to offset the great advantages possessed by the larger instrument. Let us now consider what practical benefit the astronomer enjoys from the special properties of large lenses which have just been enumerated.

Like other scientific men, astronomers who expect to accomplish much of importance at the present day find it necessary to specialize, and to devote their attention to certain classes of work in which long study and experience have given them particular skill. Thus it is that to some astronomers certain of the advantages of a large telescope appeal much more strongly than do others. In fact, in order to derive the best results from the use of the instrument it is necessary to have observations made with it by men who are capable of bringing out its best qualities in various kinds of investigation. Thus the first mentioned property of rendering visible faint objects should be utilized by an astronomer who has gained much experience in searching for and measuring objects at the very limit of vision. One who has not given special attention to this class of work would be surprised to see in a large telescope certain of the faint stars or satellites of whose discovery he may have read. When the fifth satellite of Jupiter was discovered at the Lick Observatory by Professor Barnard, in 1892, claims were put forward by certain amateur astronomers who possessed small telescopes that they themselves were entitled to the honor of the discovery, for they had seen the satellite long before. Such claims might be taken in earnest by one unfamiliar with the instruments employed by the respective observers. But it is only necessary to examine this minute object with a 36-inch or a 40-inch telescope in order to appreciate the great merit of the discovery and the absurdity of such claims as have been mentioned. The tiny satellite is so faint that hitherto it has been seen with very few telescopes, all of them having large apertures. In its rapid motion close to the surface of the great planet it is completely invisible to an eye unprotected from the brilliant light of Jupiter. Even the close approach of one of the other satellites is sufficient to cause it to disappear. In measuring the satellite Professor Barnard finds it necessary to reduce the light of Jupiter with a piece of

smoked mica, through which the planet is still clearly visible and easily measurable, though not annoying to the eye. Without an instrument like the Lick telescope the fifth satellite of Jupiter would never have been known. It may be interesting to mention here that Professor Barnard's recent measures of this satellite with the Yerkes telescope have shown that his original determination of the time of its revolution in its orbit, made five years ago at Mt. Hamilton, was not in error more than 0.03 seconds. It was found that the time of elongation differed less than half a minute from the time predicted in the *Nautical Almanac*. The period is now known within a few thousandths of a second. In this connection also it is well to add that Professor Asaph Hall's discovery in 1877 of the two small satellites of Mars was directly due to the advantage given him by the large aperture of the 26-inch telescope at the United States Naval Observatory.

Such small members of the solar system are by no means the only feebly luminous objects which great telescopes have brought to light. Faint stars in the close proximity of bright ones are usually beyond the reach of small telescopes. Thus the companion of Sirius was not seen until 1862, when the late Alvan G. Clark encountered it in his tests of the 18-inch objective now at the Dearborn Observatory, which was the largest glass that had been constructed up to that time. The small companion to Procyon, discovered not long ago by Professor Schaeberle with the Lick telescope, is another object of the same type. These are conspicuous examples of that great class of objects known as double stars, which consist of two stars revolving about their common center of gravity. From the third advantage of large instruments to which reference has already been made, it will be seen that they are peculiarly adapted for the investigation of these binary systems, not only because of their power to show faint objects in the neighborhood of brighter ones, but also on account of their capacity to separate two closely adjacent stars which in a smaller instrument would be seen as one. Thanks to this property, many interesting binary systems whose components are exceedingly close together have been found by Professor Burnham with the Lick telescope, and, although he has devoted no special attention to a search for such objects, Professor Barnard has already encountered several of them in his work with the Yerkes refractor. From what the spectroscope has taught us of binary systems, we have every reason to believe that telescopes may go on increasing in aperture almost indefinitely without ever arriving at the possibility of separating into their component parts all existing double stars. As has been stated, the Yerkes telescope can show as distinct objects stars which are no further apart than 0.″12 of arc, and on account of the elongation of the image a double star whose components are only 0.″1 apart can be distinguished from a single star. But there undoubtedly exist stars far closer together than this, some of which can be separated by an aperture of not less than forty feet.

There has been much discussion in recent years regarding the relative advantage of large and small telescopes for observations of the markings on planets. I do not propose to enter into the details of this discussion, partly because my own investigations are primarily concerned with observations of another nature, and thus have not especially qualified me to form an opinion on this point, and partly on account of the fact that additional arguments in favor of large instruments would serve little purpose. It seems to me only necessary for an unprejudiced person to examine a planet first with a small telescope of from five to fifteen inches aperture, and then to

look at the same object with an instrument of 36 or 40 inches aperture, under identical atmospheric conditions. When the seeing is distinctly bad, that is, when the atmosphere is in so disturbed a state that the images are blurred and unsteady, the smaller instrument will assuredly show all that can be seen with the larger one. But with better atmospheric conditions, to my eye at least, the advantage lies wholly on the side of the larger instrument, whether the object be the Moon, Jupiter, Mars or Saturn. In the case of the Moon particularly much fine detail which I have never been able to see with the 12-inch telescope is clearly and beautifully visible with the 40-inch. I am certainly inclined to think that large telescopes are greatly to be preferred to small ones for work of this character. But I give much less weight to my own opinion on this subject than to that of Professor Barnard, who for many years has observed the planets with instruments varying in size from a 5-inch telescope to the 36-inch on Mt. Hamilton and the 40-inch of the Yerkes Observatory. He believes a large aperture to be immeasurably superior to a small one for these observations. This seems to me quite sufficient to settle the question, for it would be difficult to name a better authority.

One incidental advantage of such an instrument as the 40-inch telescope, which depends to a great degree upon the stability of its mounting, is the ease and certainty with which micrometrical measures can be effected. Since the telescope was first ready for regular use last September, Professor Barnard has made with it a long series of micrometrical measures, which have included such objects as the satellite of Neptune, the companion to Procyon and the fifth satellite of Jupiter. The precision of these measures is most satisfactory, and lends special interest to an attempt which he has made to determine the parallax of the nebula N. G. C. 404, which is in the field with the bright star β Andromedæ. This object has a definite condensation, which permits its position to be accurately determined with reference to a number of stars in the neighborhood. A long series of measures, covering a period of five months, have led to the conclusion that the nebula cannot possess a parallax as great as half a second of arc, and, therefore, cannot be nearer the Earth than about four hundred thousand times the distance from the Earth to the Sun.

Mention should be made of one more interesting observation by Professor Barnard, which would have been much more difficult with a small telescope. It will be remembered that in the valuable work which Professor Bailey has been doing at the station of the Harvard College Observatory in Arequipa, Peru, excellent photographs were obtained of southern star clusters, which show that these clusters contain an extraordinary number of variable stars. Not only do scores of stars in a single cluster vary in their light, but the change is exceedingly rapid, occupying in some instances only a few hours. So far as I know, none of these remarkable variations had been seen visually until Professor Barnard undertook the systematic observation of one of the clusters with the 40-inch telescope. On account of the large scale of the images, he is able to distinctly see stars in the cluster without confusing them with others in their neighborhood, and has thus been enabled to follow their changes in brightness. In this way he has confirmed the variability of many of the stars on Mr. Bailey's photographs. There are few more remarkable objects in the heavens than these magnificent star clusters, so many members of which are subject to fluctuation in their light. Professor Bailey's discovery is the more note-

worthy considering the fact that such an object as the great cluster in Hercules contains not more than two or three variable stars, while the Harvard plates show that the cluster Messier 3 contains 132 variables. This is only one instance out of many of the striking efficiency of the photographic work which is being carried on under Professor Pickering's able direction.

It may be well to introduce here a few words regarding the magnifying powers employed in actual observations. The optimistic writer, who is planning to photograph houses on Mars, believes that his recent invention will render possible the use of powers as high as a million diameters, and even greater, so that if men exist upon the planets they can easily be seen. Astronomers know nothing of such powers in practice. For double-star observations, with the largest telescope and under the most perfect conditions, powers as high as 3,700 diameters have occasionally been used. But in regular work it is not a common thing to exceed 2,700 diameters. Under very exceptional circumstances the Moon might perhaps be well seen when magnified 2,000 diameters, but this would be an extreme case, and in general a much better view could be had with powers ranging from 500 to 1,000. Jupiter can rarely be well seen with a power greater than four or five hundred, though Saturn will stand considerably higher magnification. Mars is best seen with a power of five or six hundred. With small telescopes lower powers are generally used. The difficulty is not in finding optical means to increase the magnification, as some of these newspaper writers seem to imagine. It is rather a question of being able to see anything but a confused luminous object after the high eyepieces have been applied. The more or less disturbed condition of the Earth's atmosphere is mainly responsible for this, but it is doubtful whether, with even perfect conditions, such an object as Jupiter could be advantageously submitted to great magnification.

During the present century there has grown up side by side with astronomy, to which it in fact owes its existence, the new science of astrophysics. In a broad sense this science may properly be classed as a department of astronomy, but at the present time its interests are so manifold, its methods so distinct, and its relationship to pure physics so pronounced, that it may fairly claim to be considered by itself as a coordinate branch of science. While astronomy deals more especially with the positions and motions of the heavenly bodies, it is the province of astrophysics to inquire into their nature and to search out the causes for the peculiar celestial phenomena which the special instruments at the disposal of the astrophysicist bring to light. It should be added that no hard and fast line can be drawn between astronomy and astrophysics, as one of the principal problems of the latter subject involves just such determinations of motion as are particularly to be desired for the purposes of the astronomy of position. The subjects are thus intimately related and closely bound together, and the bond between astrophysics and physics is hardly less strong. They should thus be cultivated together, so that they may mutually assist one another in bringing about the solution of the varied problems with which they are concerned.

It is particularly in astrophysical research that a great telescope is advantageous. For the principal instrument of the astrophysicist, the spectroscope, it is necessary to have as much light as can be gathered into a single point. With sufficient light the chemical analysis of the most distant star resolves itself into a comparatively simple problem. But with small telescopes and consequently faint star images such analysis, except of a roughly approximate

character, is impossible with the less brilliant stars.

One of the principal problems of the astrophysicist is to determine the course of celestial evolution. It has been found that the spectra of stars are susceptible of classification in a few well defined types, which seem to correspond with different periods in stellar development. Starting from the great cloud-like masses of the nebulæ, it is supposed that stars begin to form in regions of condensation, and that the great masses of gas and vapor continue to contract under the action of gravitation, meanwhile radiating heat into space. It is known from theoretical investigations that such cooling gaseous masses not only continue to grow smaller; they also rise in temperature with the advance of time. Finally a certain point in their career is reached when the rise in temperature ceases, though the contraction of the mass is not arrested. The balls of condensing vapors continue to cool, losing more and more heat, and becoming smaller and smaller in diameter. It is perhaps at about this period in their history that they pass through such a stage as is now exemplified by the Sun, which has presumably cooled from the condition of a white star like Sirius to that of a star of the second or yellow class. The spectra of such hot stars as Sirius contain little more than dark and exceedingly broad lines, grouped in rythmical order and due to the gas hydrogen. As these bodies continue to cool the strong lines of hydrogen become less prominent, and lines due to metallic substances begin to appear. These become more and more striking, until finally we reach such a type of spectrum as that of Procyon, which is intermediate in character between the Sirian and the solar stars. From this point on we find a continual approach to the solar type, until at last stars are reached whose spectra agree line for line with that of the Sun. After passing through the condition of the central body of the solar system the yellow and orange color of the stars becomes more pronounced, and subsequently a reddish tinge appears, until finally stars of a deep red color are found, which seem to mark the last stage of development before complete extinction of light. Through a part of this line of evolution it is easy to trace the changes in stellar spectra, the solar lines still continuing to be present, and superposed upon them a remarkable series of flutings which are characteristic of these reddish stars of the third class. But between such stars and those of the class which Vogel has designated as IIIb there seems to be a break in the evolutionary chain.

Stars of Class IIIb are of an orange or red color, and with the telescope alone some of them cannot be distinguished in appearance from the more fully developed stars of Class IIIa. But in the spectroscope they are entirely different. All of these objects are extremely faint, the two brightest of them being hardly visible to the naked eye. For this reason but little has been learned of their spectra, although the spectra of stars like Vega and Arcturus, which are some scores of times more brilliant, have been carefully investigated by both visual and photographic means. According to Dunér and others, the spectrum of the star known as 152 Schjellerup consists of certain heavy, dark bands, which coincide closely in position with bands given by compounds of carbon, and, in addition to these, a luminous zone in the orange portion of the spectrum. Three or four of the most intense solar lines have also been detected in these objects. But beyond this it is impossible to go with the appliances used in the earlier investigations, although it may well be that photographic methods would have greatly changed the character of the results obtained.

During the past winter a photograph-

ic study of the red stars has been rendered possible by the 40-inch Yerkes telescope. Photographs of the spectra of many objects of this class have now been obtained, and many lines which were not previously recognized on account of the faintness of the spectrum in small telescopes have been recorded. In the case of two stars of Class IIIb, 132 and 152 Schjellerup, the spectra have been photographed with a powerful spectrograph containing three prisms, giving high dispersion and considerable precision to the measures. It has been found that among the most characteristic features of these spectra are numerous bright lines, some of which seem to have been glimpsed by Secchi in his pioneer work at the Collegio Romano, though his drawings do not correctly represent their appearance or position. In fact, he recorded bright lines where none exist, and failed to record others, among which are the brightest in the spectra. Both Dunér and Vogel, who are certainly to be regarded as the best authorities on the subject, altogether deny the presence of bright lines. And had my own observations been confined to an examination of the spectra with the instruments used by these observers I would unhesitatingly subscribe to their opinion. But the great light-collecting power of the 40-inch telescope renders the detection of the bright lines a comparatively easy matter. Even with this instrument, visual observations with the low dispersion spectroscopes used by Dunér and Vogel would hardly show them, but they are easily seen with a three-prism spectroscope, and they have been repeatedly photographed with one and with three prisms. Some of these photographs have been measured and the wave-lengths of the bright and dark lines determined. A comparison of the results with those obtained for other types of stellar spectra suggests certain interesting relationships, which, if confirmed by subsequent work, will be of service in tracing the course of stellar evolution.

This is only a single instance of the advantages for stellar spectroscopic work of the great light-collecting power of large telescopes, but it would be easy to multiply examples. Our knowledge of the peculiar spectra of the stars of the Wolf-Rayet class, all of which are found in the Milky Way or its branches, is due in large part to the visual and photographic study of these faint objects made by Professor Campbell with the Lick telescope. In the able hands of Professor Keeler, whose recent election to the directorship of the Lick Observatory is so truly a cause for congratulation, the same powerful instrument rendered possible the determination of the motion in the line of sight of the planetary nebulæ. We may well be confident that the future record of the great telescope on Mt. Hamilton will be marked by many similar advances.

I might profitably go on to speak of the advantages of large telescopes for the study of the Sun, for in no field of research can they be better employed. In photographing the solar faculæ with the spectroheliograph the large image given by a great telescope is particularly useful for purposes of measurement, as well as for the study of the form and distribution of these phenomena. Prominences, too, whether of the quiescent or eruptive class, are best photographed on a large scale. With a large image it may also become possible, under good atmospheric conditions, to photograph some of the delicate details in the chromosphere, which, with a small solar image, would be wholly beyond the reach of the photographic method. It is probably in the study of the spectrum of the chromosphere, however, that one best perceives the advantage of a large instrument as compared with a small one. Recent experience has made this very clearly evident, for with the 40-inch Yerkes telescope

it has been possible to see in the chromospheric spectrum a great number of faint bright lines which were wholly beyond the reach of the 12-inch telescope used in my previous investigations. In this way it has been found that carbon vapor exists in the vaporous sea which covers the brilliant surface of the photosphere.

It will be admitted, I think, from what has been said, that great telescopes really have a mission to perform. While, on the one hand, they are not endowed with the almost miraculous gifts which imaginative persons would place to their credit, they do possess properties which render them much superior to smaller instruments and well worth all the expenditure their construction has involved. In answering the question: 'Do large telescopes pay?' it is simply a matter of determining whether the work which cannot be done without the aid of such telescopes is really worth doing. No one who is familiar with this work is likely to deny that it is worth all the money and time and labor that can be devoted to it. I therefore confidently believe that the generous benefactions which during the last quarter century have permitted the erection of large telescopes in various parts of the world have been wisely directed, and that further sums might well be expended, particularly in the southern hemisphere, in the establishment of still more powerful instruments.

George E. Hale.

JULIUS SACHS.*

After great suffering, Julius Sachs sank peacefully to rest at six o'clock on the morning of the 29th May, 1897, at Würzburg, the scene for many years of his labors. Wherever scientific botany has a home, and by many outside the narrow circle of specialists, this loss has been regarded as irreparable. By no one has it been felt more keenly than by the writer of these lines, who will always thankfully recall the happiness it has been to him to have been closely connected throughout a long series of years as pupil and friend with him who has passed from our midst.

When I attempt to briefly sketch the life of the man to whose brilliant intellect botany is so greatly indebted, there rises involuntarily to my mind the saying of Petrarch's:

Si quis tota die currens
Pervenit ad vesperam satis est.

Yes, his life was a struggle, a ceaseless, single-minded pressing forward without rest to the goal of knowledge. To him study, research, teaching, were not merely the external activities of his calling that might be laid aside for hours, days or even weeks, and then be again resumed. They absorbed his whole being more than was good for his personal welfare. But the evening came after this long day in which he had so faithfully labored. No one realized this more fully than he himself. A prey to physical suffering, his sharpest pang was that he could no longer work for science with his former energy, and if anything made it hard for him to face death it was the knowledge that he must leave behind as an unfinished sketch much that he wanted to say to the world.

He had been chiefly occupied during these last years with a work which, under the title of *Principien Vegetabilischer Gestaltung* (*Principles of Vegetable Form*), was to set forth his views upon causal morphology. "I should feel it an immense grief if I were prevented from writing this book," he says. "It would embody the thought of forty years, and it is always important that one's ideas should be long and thoroughly brooded over. To finish it would render the last

* A translation for *Science Progress*, by Miss E. D. Shipley, from an article by Professor K. Goebel in *Flora*.

years of my truly miserable existence in some degree bearable." *

Sachs was essentially a 'self-made man,' who found it by no means a light matter to attain the eminence which led the most distinguished German universities each to desire to win him for itself. The story of his early years, as it appears in these pages, is taken from an autobiography intended for his own family, Fräulein M. Sachs having kindly made extracts from it for my use. It will be of great interest to many who only knew him as a mature man occupying an honorable position to learn how literally true were the words 'tota die currens.'

Sachs was born on the 2d October, 1832, at Breslau, where his father was an engraver. For a time his parents lived in the country, and this may have contributed to the early awakening of his mind to the beauty of nature, at which he always looked as much with the eye of an artist as with that of an observer. The design that he cherished at one time of writing a work on the beauties of the plant-world was unfortunately never realized. It would have been of the greatest interest if he, an adept in the art of word-painting, an enemy to all affectations and mannerisms, had given us his thoughts upon this theme.

His first experiences of school life were not pleasant. Learning by heart, that purely mechanical acquisition of knowledge, was a burden to him, as it has been to many another highly gifted scholar. Of much greater importance than his school instruction was his father's training in drawing. From his thirteenth to his sixteenth year he drew and painted flowers, fungi and other natural objects, and his artistic talents played, as we shall see later, an important *rôle* in his career.

His family possessed but few books, and the boy felt stirring within him a longing, doubtless inexplicable to himself, for intellectual advantages. And thus his brother's acquaintance with the sons of the physiologist Purkinje,* at that time a professor at Breslau, was of great importance to him. His brother brought home the *Penny Magazine* from these playfellows, and the prehistoric animals depicted in it aroused so great an interest in Julius, then as always thirsting for knowledge, that although he could not understand the English text the 'extinct monsters' appeared to him most realistically in his dreams! Later he himself came to know Purkinje's sons, and this acquaintance shed a ray of light upon his life; for the first time he saw a refined home, free from all petty cares as to daily bread, filled by stirring intellectual life, and dominated in every detail by the imposing figure of the white-haired professor who inspired Sachs with the greatest respect. Julius learned from his sisters to press plants and heard that there were such things as botanical collections; he proceeded to start one for himself. His father, who knew the popular names of many plants, encouraged these endeavors. They made expeditions in the early morning hours, and at fourteen years old Sachs could already determine his plants according to Scholtz's 'Flora.' But his herbarium was stolen, and this was his first bitter, deeply felt grief. He related his loss to every one and could not understand that other people failed to recognize its gravity. He never again collected plants until in later years, as professor, he started an herbarium for the purposes of demonstration. The way in which at the present day so many botanists entirely neglect the practical knowledge of plants was

* The quotations are principally taken from letters.

* J. E. Purkinje (1787–1869) was professor of physiology and pathology in Breslau from 1823 till 1850, and afterwards in Prague. He was the author also of a botanical treatise (*De cellulis antherarum fibrosis nec non granorum pollinarium formis commentatio phytotomica*, Breslau, 1830).

wholly distasteful to him, as the following remark in one of his letters shows: "I strongly disprove of the so-called 'physiologists,' to whom the commonest meadow and garden flowers are unknown, especially as such people generally have but little knowledge of physics." And if he complained many a time in joke of the foolishly unnecessary and tedious multiplication of phanerogamic varieties he was far from undervaluing the knowledge and study of them. Indeed we shall come across instances of the keen interest in the common problems of systematic botany which constantly appears in his writings.

It was his mother who conceived the thought of allowing him to attend the gymnasium, a privilege accorded to none of his brothers, for this considering the family poverty involved no slight risk.

The years he spent at the Elizabeth gymnasium formed a bright picture in Sachs' life. The school work was congenial to him; it lifted him out of the petty surroundings of his home-life into a higher sphere. He attended the gymnasium from 1845 to 1850. Of the masters only one—Dr. Rumpelt—came at all into personal contact with him. He recognized Sachs' exceptional talents and the two became good friends. On the other hand, the natural science master, the lichenologist Körber, only repelled him. Körber could not instruct and had no conception how to impart anything worth knowing about his subject. Sachs, therefore, worked on at his scientific pursuits unaided and undirected. He read eagerly, without its doing him any harm, Oken's 'Philosophy of Nature,' which he had bought at a sale for a few pence, began to make a collection of skulls, and wrote a monograph on the crayfish. Körber's attention was drawn to this work by Dr. Rumpelt; he sent for Sachs and solemnly warned him against devoting himself to natural science, on the ground that it would not bring him in a half-penny! One cannot but rejoice that this advice was not acted upon.

In the year 1848 Sachs lost his father, and in the following year his mother. Thus orphaned, he lived at first with his brother, where, to his great joy, he was alloted a room in the roof which, otherwise unattractive, afforded him the opportunity of carrying on his scientific studies in his scanty leisure. Here, for instance, he mastered the Latin Anatomy of Bartholinus. It became more and more imperative, however, that he should face his position. He left the school (having risen to the upper second form) and wished to go to sea.

In the meantime Purkinje had been called to Prague. He remembered his son's friend and wrote suggesting that Sachs should come to him as a kind of private assistant. He was to prepare natural science drawings and in return to receive the modest salary of 100 florins a year and his keep.

After numerous difficulties with his guardians, Sachs left Breslau on the 14th of February, 1851, for Prague. He found there shelter, it is true, but no home. Purkinje was a man of high attainments, for whose genius Sachs had great respect. But their peculiar temperaments made it impossible for them to understand each other, and the elder naturalist had no word of recognition, sympathy or encouragement for the younger. He was of peasant origin and this stuck to him all his life. Sachs, on the other hand, felt himself—as he said with reason, in spite of the reduced circumstances of his family—to be a born aristocrat, and so there could not fail to be friction between them.

Whilst Sachs was at Prague the question arose whether he should remain simply an illustrator of scientific writings or should carry on his studies further. Fortunately, he decided upon the latter course, and, despite the time that had elapsed since he left

school, successfully passed his matriculations at Prague in the autumn of 1851 with a view to entering that university.

The young student was already too independent and critical to be an ardent frequenter of the lecture room, where it would have required a man of exceptional ability to have secured his attendance, and it was evident that there were at that time but very few such men at the University of Prague. Botany was represented by Kosteletzky, who was lecturing upon Schleiden's works. Sachs attended two or three lectures and then stayed away; the truth was that he needed no teaching on this subject. He paid special attention to chemistry, physics and mathematics. But the only man who attracted and helped him on was Robert Zimmermann,* who invited him to his house. "I went to him with an inclination towards philosophy, but he directed me into the right way," Sachs says, speaking of Zimmermann; "he and my earlier teacher, Rumpelt, are the only two who gave me any real help; apart from their aid I am self-taught." He read a good deal of philosophy after he had become acquainted with Zimmermann—Herbart, Leibnitz, Kant, Locke, Hume and even the Schoolmen. At the same time he was privately working at zoology and botany, and for several years paid special attention to physics and mathematics. In 1856 he was made Doctor of Philosophy, a degree which at that time was hard to obtain at Prague. His outward circumstances, since he had separated from Purkinje, remained precarious; he earned small sums by literary work, drawings of fossils, etc., and at this time made his first experiments in the physiology of plants. In 1857 he was made privat-docent in plant physiology. Up to that time this had not been a recognized subject and there were various difficulties to overcome. "Two lectures are ample for all there is to say upon the physiology of plants," said Rochleder, the chemist, and at that time he was not so very far wrong.

Sachs, who later was certainly the best teacher that the new botany has produced, was by no means a success as privat-docent. One reason for this may be that he took but slight interest in the art of teaching. He lived wholly for science and was beyond measure studious; "it engrossed my thoughts even when I was out walking," he says. This being so, it came to him, according to his own account, more or less as a revelation that what he had to do was not only to acquire as much knowledge as possible, but also to produce some original work. From that time he only sought to work out his own ideas, to attain his own aims. He became acquainted with several of the chief exponents of botany of the day, such as Unger, Nägeli and Alexander Braun, all of whom he met at the Natural Science Congress in 1856 at Vienna; and also about 1857 with Hofmeister who, in the intercourse that lasted between them for many years, influenced Sachs strongly, though, as the latter considered, at times in such a way as to perplex him.

In the meanwhile he was finding his life in Prague almost unbearable. The patriotic Czechs of the National party opposed him as a German, and openly told him that they wanted to drive him away. Whilst this was going on, the attention of Professor Stein, the well-known zoologist, had been directed to Sachs. Stein had formerly devoted some of his time and energy to the Academy of Forestry at Tharandt and introduced Sachs to the chemist Stöckhardt, the director of this institution. Sachs was invited to draw up a statement as to the relation of plant-physiology to agriculture, with the result that he was called to Tha-

* Robert A. Zimmermann, born at Prague, in 1824, studied philosophy, mathematics and natural science, became professor of philosophy at Prague in 1852, and since 1861 has held the same chair at Vienna.

randt as physiological assistant in 1859. He went there in the March of that year. His chief work here was to show that land plants could be raised in aqueous solutions of nutrient salts, but he was busy at the same time with other physiological experiments. 'Die Entdeckungen lagen damals am Wege' was his opinion, 'die Botaniker trieben andere Dinge.' Even then Nägeli, for instance, described Sachs' researches as belonging to the chemistry of agriculture; there was as yet no talk in Germany of the chemistry of plant-physiology.

In summer he started work at four o'clock in the morning, and by so doing found time during the years 1859 and 1860 to study the earlier plant physiologists besides doing his own work. These literary studies caused him, in 1860, to suggest to Hofmeister that they should edit a large hand-book of botany, in which the collected results of what we now call 'general' botany should be critically set forth. The *Handbuch der physiologischen Botanik* remains, as is well known, a fragment; various collaborators who had undertaken certain parts drew back, and Hofmeister fell ill and died in 1877 without being able to complete his share; but in spite of all mishaps the four volumes that appeared rank among the most valuable productions of more recent botanical literature. Sachs had frequently to give addresses at agricultural meetings and so gained the useful knowledge that he had a natural gift for public speaking.

In the winter of 1860–61 he was invited to become the head of the recently established agricultural department of the polytechnic at Chemnitz. His position there bristled with difficulties, and he welcomed the proposal that he should accept the chair of botany and natural history at Poppelsdorf, near Bonn, whither he removed in 1861. Here he married and in time became the father of two daughters and a son.

As regards science the six years spent at Bonn are among his most fruitful. Besides a number of other works, it was here that his 'Experimental Physiology' was written and the 'Text-book' begun. His lectures were highly appreciated, and at the end of two years he was relieved from lecturing upon mineralogy and zoology; henceforward he dealt only with physiology during the winter, and in the summer delivered special lectures on agricultural plants. There was but little intercourse between him and the botanist Schacht, who was then at Bonn, but who was already in bad health, and whose temperament was thoroughly uncongenial to his own. With Schacht's successor, Hanstein, on the contrary, friendly relations ensued. On New Year's Eve, 1866, he received the news that he had been called to Freiburg im Breisgau as successor to De Bary; he went there in April, 1867. A small salary and a poor garden formed two undesirable elements in his life at Freiburg, and after three terms he willingly left to go to Würzburg. There, as we know, he remained, in spite of brilliant offers to move elsewhere. As early as 1869 he received a call to Jena, in 1872 to Heidelberg, in 1873 to Vienna, in 1877 to Berlin, where later they tried to obtan him for the Agricultural College; he was also invited to Bonn under tempting circumstances. When Nägeli retired, the professorial chair at Munich was offered him. It is much to be regretted that he did not accept one of these invitations whilst his health was still good, especially as the climate of Würzburg is hardly favorable to nervous constitutions. It may, perhaps, have been the needs of his family, which pressed heavily upon him, or attachment to all he had acquired at Würzburg and dislike to the loss of time and strength inseparable from each change of place, that kept him there. The government testified its appreciation by investing

him with titles and orders; as early as the autumn of 1871 his colleagues chose him for their rector, and he was repeatedly elected to the Senate.

With the commencement of his professional life at Würzburg, Sachs' 'Wanderjahre' came to an end. They had been, as the preceding facts show, beset with difficulties. "I was thirty-six years old when, with a salary of about 2,000 guldens, I came to Würzburg and found a hole in which to hide my head. During the three previous years, in which I had laid aside the 'Experimental Physiology' and had been writing the 'Text-book,' I had had a severe struggle, in the strictest sense of the word, to provide for the wants of my family. I was thirty-seven years old when I succeeded for the first time in investing 200 thalers in the public funds, and had for twenty years daily worked from fourteen to fifteen hours. As you see, my life has not been an easy one, and yet I wish that things went as well with me now as they did then, for what I have been through since is truly more than a man can bear."

The strong expression that he uses in speaking of the laboratory at Würzburg shows that there was much to be desired both in it and in the gardens attached to it. The laboratory which under his direction obtained a world-wide reputation and attracted young botanists from all parts was housed, together with the clinical schools and the Institute of Pharmacology, in a building that contrasts most modestly with the handsome modern structures that have arisen in many universities. And yet how much he accomplished in it! Little by little the whole of it came to be given up to botanical purposes, Sachs being much too modest to insist on a new botanical laboratory in spite of the fine new buildings that were erected for the other sciences. He contented himself with the addition of a very beautiful and suitable lecture-room. He was particularly anxious about the garden, which was laid out on barren soil made up chiefly out of the rubbish-heap of an old fortress. He gave it his own personal and devoted attention, and was rewarded by a luxuriant vegetation where formerly there had been but a barren waste. Later on he divided off a small part of the garden for special purposes, and this he attended to himself with the help of his laboratory servant. There he made open-air experiments, and there also was the well-known *Schilderhaus* (sentry-box) for experiments in etiolation, etc. The cultivation of strong, healthy plants for the purposes of investigation was in his opinion an essential part of experimental physiological work; he excelled in the art and deemed it worthy of individual, personal attention. There were almost invariably plants growing in his work-room, but in the summer time, when growth was going on in the plant-world, it was essential to him to make constant observations out of doors and to meditate upon his investigations as he strolled about the garden.

The astonishing amount of work that he managed to get through from his earliest days could not but affect his constitution. He said himself that he had paid for each of his books with wearisome ill-health, and even the strongest nerves could not stand such ceaseless labor. Added to this came his wife's long tedious illness which undoubtedly helped to undermine his strength.

Bearing these facts in mind, it is perhaps more possible to form a just estimate of his relations with the outer world. The latter part of his life found him a lonely man who had estranged many of his friends by bitter and sometimes even unjust criticisms. We shall perhaps condone his trenchant animadversions upon the botanical writings of his day if we remember how his sensitive, highly strung temperment must have suffered at times from the irritation of private

affairs. And then again, science represented to him all that is highest in life, and it followed that any work which he considered bad from a scientific point of view seemed to him a crime. More than this, much that appeared of great importance to others had no weight with one who regarded the mission of science from so high a standpoint and whose refined nature could not fail to despise all ambiguity, empty phrases and affectations in its literature. He considered the great defect in this to be that, whilst each isolated investigation is deemed a personal achievement and quoted as such, important generalizations were regarded as impersonal property. He was by no means a man who could not endure contradiction and was always ready to listen to it when well founded; it was only when the opposition seemed to rise from incapacity and stupidity that he was roused to fierce anger. His standpoint is best described in the following words written to a friend at the end of a keen discussion: "After all, in science, as in ordinary life, all hinges upon whether a man accept the general point of view of his opponent; when that is done it is always possible to arrive at some satisfactory conclusion, and I hope this will always be the case with us."

Although the purely intellectual side of his nature outweighed the emotional, he was invariably grateful for the smallest services, and to me he always proved an indulgent, lovable teacher. At the same time he could coldly repel all who were uncongenial to him. He agreed with Goethe, 'Sage nur von deinen Feinden, warum willst du gar nicht wissen,' etc.

As time went on he became more and more dissatisfied with the state of botanical literature. Such dissatisfaction, however, did not keep him from incessant toil whenever he was well enough, and more especially when the sun shone. Like Goethe and many other sensitive natures, he was strongly affected by sunshine or the lack of it. "If you imagine yourself transplanted from Java to Bavaria and that the sun's face has been veiled for the last three weeks by a layer of sail-cloth 100 meters thick, you may form some conception of the vegetation in our garden. The grass and leaves grow as though this were a dairy-farm! Every one is charmed with our luxuriant vegetation, but there are no signs of blossoms. It is as dark at four o'clock as it would be at the same hour at Christmas, and it has been like this for the last three weeks. I should not complain, liking as I do to take things as they come, but unfortunately I cannot live without sunshine and the lack of it makes me ill."

(*To be concluded.*)

CURRENT NOTES ON ANTHROPOLOGY.

THE 'MONUMENTAL RECORDS.'

A PERIODICAL recently started in New York City should be mentioned in these notes. It is entitled *Monumental Records* and is edited by the Rev. Henry Mason Baum. As its title indicates, it is concerned with the discovery of ancient monuments, including those of both the Old and New Worlds. In the three numbers which have already appeared there are descriptions of the ruins in Yucatan and Mexico by Mr. Marshall H. Saville, translations of the Moabite stone, descriptions of the remarkable exhumation of Greek manuscripts in Egypt, a report of Mr. de Morgan's work in the same country and a running series of archæological and literary notes by the editor.

The subscription price for this handsomely illustrated periodical is placed at the moderate sum of $1.50 a year and the address is 'Box 1839, New York City.'

THE PASSAMAQUODDY WAMPUM RECORD.

IN the *Proceedings* of the American Philosophical Society for December, 1897,

Professor J. Dyneley Prince has a most interesting article on the wampum records which have been preserved among the Passamaquoddy Indians. These symbols were rendered to him in the native dialect by a chief of the tribe, and this text is given, together with a translation into English. The method of memorizing is stated to have been that certain combinations of the shell beads suggested certain sentences or ideas. There were different varieties, the one referring to marriage ceremonies, another to funerals, to installations and the like. Examples of several of these are supplied.

It does not seem that wampum-belts were in use and Professor Prince did not find the strings themselves. His article is one of peculiar value on the still obscure subject of the uses of wampum and the manner in which it served mnemonic purposes.

THE SIGNIFICANCE OF THE SCALP-LOCK.

THE last number of the *Journal* of the Anthropological Institute contains an article by Miss Alice C. Fletcher on the significance of the tuft of hair or scalp-lock so common among the American Indians. It is drawn from her study of the Omaha tribe and their religious ceremonies. One of the most solemn of these is that of the first cutting of the hair of the children. The meaning of this rite was some sort of a consecration of the child to the God of Thunder, who was spoken of as 'grandfather.' The sign of the consecration was the small lock of hair left on the crown of the head and separately braided. It symbolically represented the life of the man, and from this arose the custom of scalping the enemy who was slain in battle, as his life thus passed into the power of his conqueror.

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CURRENT NOTES ON BOTANY.

THE MORPHOLOGY OF GINKGO.

THE morphology of the Ginkgo has puzzled botanists not a little, although on account of its oddity the tree has been studied by a good many investigators. Every botanist is familiar with the naked stalks usually bearing two ovules at the summit, which have been regarded quite generally as axial in nature. This is the view held by Eichler in *Die Natürlichen Pflanzenfamilien* in 1887, and the genus is assigned to a place in the Coniferae in accordance therewith. Essentially the same view was held by Sachs in his 'Text-Book,' Goebel in his 'Outlines of Classification and Special Morphology of Plants,' Strasburger in 'Coniferen und Gnetaceen,' as well as by systematic botanists generally. On the other hand, Van Tieghem in his 'Traité de Botanique' (1891) regarded the ovule-bearing stalks as foliar in nature. In a footnote in my 'Botany for High Schools and Colleges' (1880) I wrote as follows: "The morphology of the flowers of Ginkgo, as here given, is by no means satisfactory. Instead of the ovules being borne upon naked axes, it is probable that they are in reality upon foliar organs, *i. e.*, either upon modified leaves somewhat as in Cycas, or upon elongated homologues of the 'scales' of Abies. Either interpretation would necessitate a considerable change in the systematic arrangement of Taxineæ."

In the *Botanical Magazine* (of Tokyo) for February and March, 1896, Kenjiro Fujii began a discussion of the views held regarding the morphology of the flowers of Ginkgo, and completes his paper nine months later by publishing the third installment in the number for December, 1896. The paper is accompanied by a plate in which the foliar nature of the ovule-bearing stalks is proved with the greatest certainty. All gradations are shown from the slightly modified leaf, through leaves

having a pretty well developed blade and bearing one or two ovules, to the usual naked stalk bearing one or two ovules. An examination of this plate is conclusive as to the foliar nature of the structure bearing the ovules. The homology of these structures with the ovuliferous leaves of Cycas is quite evident.

The anthers, which are born in catkin-like clusters, are shown by the same writer to be borne upon much modified leaves. The so-called 'staminate catkin' is, therefore, a single stamen bearing many anthers, reminding us again of cycas, in which, however, the antheriferous leaves are broad and the anthers sessile.

THE RE-ARRANGEMENT OF THE GYMNOSPERMS.

THE 'considerable change in the systematic arrangement of Taxineæ,' referred to above, came very shortly after the publication of Fujii's paper, aided very greatly by Hirase's discovery of antherozoids in Ginkgo, and Ikeno's almost simultaneous discovery of antherozoids in Cycas, also. In the first Lieferung of the 'Nachtrag zu Teil, II.–IV.,' of the *Pflanzenfamilien* (1897) Engler suggests a new classification of gymnosperms as follows:

GYMNOSPERMÆ.

CLASS CYCADALES, fecundation by spermatozoids.
CLASS BENNETTITALES.
CLASS CORDAITALES.
CLASS GINKGOALES, fecundation by spermatozoids.
CLASS CONIFERAE, fecundation by non-ciliated sperm-nuclei.
CLASS GNETALES, fecundation by non-ciliated sperm-nuclei.

In the eighth Lieferung of the 'Nachtrag' (dated October, 1897) this is further modified as follows:

GYMNOSPERMÆ.

A. Fecundation by spermatozoids.
 CLASS CYCADALES.
 CLASS BENETTITALES (extinct).
 CLASS CORDAITALES (extinct).
 CLASS GINKGOALES.
B. Fecundation by sperm-nuclei.
 a. No true perianth.
  CLASS CONIFERAE.
 b. A perianth present.
  CLASS GNETALES.

This rearrangement brings about a good deal of confusion in the chapter relating to the conifers in the *Pflanzenfamilien.* We are now asked to rearrange that text so as to divide the class (after excluding Ginkgo) into two groups, viz.: Taxaceae (including Podocarpeae, with genera *Saxegothaea*, *Microcachrys*, *Podocarpus* and *Dacrydium*, and Taxeae with genera *Phyllocladus*, *Cephalotaxus*, *Torreya* and *Taxus*) and Pinaceae (now arranged under Araucarieae, Abietineae, Taxodieae and Cupressineae). We have thus a division of Conifers into a lower family (Taxaceae) and a higher (Pinaceae), and this is the sequence we are to recognize, while in the higher family the four tribes are arranged in a descending series.

The editor of the *Pflanzenfamilien* should issue a revision of the pages of 'Teil II.,' which deal with the gymnosperms (about 130 pages) in order that at the approaching completion of the work it will not be marred by the present patchwork arrangement.

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SCIENTIFIC NOTES AND NEWS.

THE RECENT ECLIPSE.

AT the Royal Institution on April 29th Mr. W. H. M. Christie, the Astronomer Royal, gave a discourse on 'The Recent Eclipse.'

Mr. Christie said, according to the report in the London *Times*, that he was afraid that his account of the eclipse would be somewhat imperfect, because the reports of the various observers had not yet been published, and the information he had been able to glean as to the results obtained by the parties of American, Japanese and Italian observers was somewhat meager. After the failure from bad weather, which was the fate of nearly all the expeditions in the eclipse of 1896, it was felt that every ef-

fort should be made to occupy as many stations as practicable along the track of the last eclipse, which, starting from Equatorial Africa, crossed India and ended in the Chinese Empire. It was not, however, found possible to send an observing party to Africa; so the field was narrowed to the shadow track through central India. There the choice of stations was practically confined to the neighborhood of the places where the various railway lines intersected the central line of the shadow, and of these the more westerly had the advantage of giving slightly longer duration of totality. The Joint Eclipse Committee arranged for four parties of observers. Sir Norman Lockyer, whose main equipment consisted of prismatic cameras, was at Viziadrug; Professor Turner and the lecturer, who originally intended to station themselves at Karad, near Poona, were obliged, on account of the outbreak of the plague, to go instead to Sahdol, a place farther east with a shorter duration of totality; Captain Hills and Mr. Newall were at Palgaon with slit spectroscopes, and Dr. Copeland took large-scale photographs of the corona with a lens of 40ft. focus. In addition there was a party, under the auspices of the British Astronomical Association, at Talni, consisting of Mr. and Mrs. Maunder, Mr. Thwaites and Mr. Evershed; the Viceroy of India was in the neighborhood of Buxar, near Benares, with a large party which included Mr. Pope, of the Indian Survey, and there were three other parties of observers near Jeur, to the southeast of Poona. The track of the shadow was thus very well occupied throughout India. Admirable arrangements were made by the Government for the observers, who were also indebted to the Indian railway companies for their liberal treatment. Mr. Christie then passed on to consider some of the results obtained. Beginning with photographs of the corona, he said that a special feature was the number and variety of instruments utilized to take these on the large scale of about 4in. to the sun's diameter. Professor Campbell, Dr. Copeland and Mr. Michie Smith had each a telescope 40ft. long, the form of mounting being different in each case. The instrument he himself used was on a different principle, the large scale being obtained by applying a concave lens to magnify the image formed by an object glass of comparatively short focal length. Thus the total length of the telescope was kept within manageable dimensions—11ft. in his case instead of 40ft. as in the ordinary form. Another important feature in the instrumental equipment was the coelostat—a form of mounting a mirror devised by Mr. G. Lippmann in 1895, and successfully used in the recent eclipse at three stations—Sahdol, Palgaon and Viziadrug. Another interesting new departure was Professor Burckhalter's device for giving to each part of the corona the exact exposure best suited to its brightness. He arranged to get the whole on one plate by using a slit of peculiar form in a metal screen which rotated rapidly in front of the photographic plate. Numerous spectroscopic observations were carried out both with slit spectroscopes and prismatic cameras, and Mr. Newall attempted to determine the relative motion in the line of sight by the displacement of the corona lines in the spectrum. Professor Turner made polariscopic observations to discover how much of the light of the corona was polarized, and Mr. Newall noticed strong polarization of the atmosphere at all points within 30 minutes of the sun. At Sahdol temperature observations were made, and a fall of 8 degrees was registered 20 minutes after totality. At Buxar a kinematograph was employed, but the film had since disappeared. In conclusion, Mr. Christie, remarking that the form of the corona was not quite what was expected, said that in this connection it was a suggestive fact that at the time of the eclipse there were more spots than usual on the sun at that epoch of the cycle, and that from January 15th to January 21st great magnetic disturbances were registered at Greenwich. The lecture was illustrated with many lantern slides, and a number of photographs were displayed in the library.

THE BENEKE PRIZES.

THE Philosophical Faculty of the Georg-Augustus University of Göttingen has just published, according to *Nature*, the following information concerning the Beneke prizes for the years 1897 and 1901: On March 11, 1898, the birthday of Carl Gustav Beneke the founder of

this prize, it was announced that no communication had been sent in for the prize competition for the year 1897. At the same time the Philosophical Faculty set the following problem for the year 1901: The principle of continuity, or, more exactly, the representations by functions which can be indefinitely differentiated, has for a long time been regarded as a general valid foundation for the mathematical treatment of natural phenomena. Such a groundwork as this was quite naturally introduced by the discoverers of the differential and integral calculus. More recently, however, the progress of mathematical investigation has shown generally that this is founded on a great number of implicit suppositions to which we, in consequence of the inaccuracies of our sensitive perceptions, are not bound. Further, the assumption of the molecular constitution of matter is from the first in contradiction with well-known laws. The Faculty wishes to receive a work of real scientific interest in which such questions will be treated in a general intelligent way, and in which a minute examination will be made regarding the admissibility in relation to the appropriateness of the usual mode of representation. Communications may be mathematically or philosophically and psychologically inclined, and historical studies are desired but not demanded. Papers competing for this prize must be written in a modern language, and will be received by the Dekan of the Philosophical Faculty up to August 31, 1900. A motto should be written on the title-page of the work and on the outside of a sealed letter which must accompany it, containing the name, profession and address of the sender. In no other way can the name of the author be communicated. It is further requested that the address of the sender should be also written on the title-page, in case the prize should not be awarded to it. The first prize amounts to 3,400 Marks, and the second to 680 Marks. The prizes will be awarded on March 11, 1901, at a meeting of the Philosophical Faculty in Göttingen. The communications to which prizes are awarded remain the property of the authors. The prize problems, for which the competitive papers must be sent in by August 31, 1898, and August 31, 1899, will be found given in the *Königlichen Gesellschaft der Wissenschaften Geschäftl. Mittheilüngen*, 1896, S. 69, 1897, Heft. 1, S. 26.

THE STATISTICIAN OF THE TREASURY DEPARTMENT.

THE New York *Evening Post*, of May 7th, states: Worthington C. Ford, Chief of the Bureau of Statistics in the Treasury Department, is the latest victim of the rush for office. He will retire on Monday of next week, making way for O. P. Austin, a former newspaper correspondent who made a specialty of furnishing statistical leaflets and circulars for the Republican National Committee during the last Presidential campaign. Mr. Hanna then promised him a position of importance, and he has now made his promise good, though at a heavy cost to the administration, under whom Mr. Ford had worked faithfully and as efficiently as he did under President Cleveland.

Mr. Ford is one of the most prominent statisticians in the country. He is an indefatigable worker, and has not only the statistical instincts, but the culture brought by long exercise of the art. He was chosen by Secretary Carlisle and President Cleveland from a large number of persons whose names had been mentioned to them, and wholly on the ground of personal merit and professional skill. It was one of the few appointments made wholly regardless of politics, and in the face and teeth of opposition from big Democrats, to whom Mr. Ford's sincerity of purpose, and his unqualified adhesion to true revenue reform and sound finance, irrespective of partisan or local interests, were repugnant. No fault, it is understood, has been found with his work, which has never fallen short of the highest grade. But he does not understand bending every other statistical consideration to the upbuilding of the Republican theory, and the purveyors of party patronage proved too strong for the conservative forces which have assured his retention so far.

The position from which Mr. Ford retires is under the civil-service rules, as extended by President Cleveland. To the world at large it is known as Chief of the Bureau of Statistics of the Treasury Department. In the section of

the revised statutes, however, which authorizes its creation, it appears simply as a division clerk, to be appointed by the Secretary of the Treasury, to 'superintendent of the bureau.' The question is likely to arise, therefore, how Secretary Gage is going to get Mr. Austin into the position vacated for him, as he is not now in the civil service.

One of two things may be done—either the same plan will be followed to which resort was had in the cases of Chief Clerk Michael, of the Department of State, and the late Director Smith, of the Bureau of American Republics, the appointment being temporarily made and a special examination held afterward, or advantage may be taken of the use of the term 'appoint' in the statute, and the assumption made that the power of appointment was absolutely vested in the Secretary, as distinguished from those positions of which he simply 'designates' a clerk to take charge.

GENERAL.

THE University of St. Andrews will confer its honorary LL.D. on Professor William Osler, of Johns Hopkins University.

MR. W. H. PREECE has been elected President of the British Institution of Civil Engineers.

PROFESSOR CH. RICHET, the well known physiologist, editor of the *Revue Scientifique*, has been elected *membre titulaire* of the Paris Academy of Medicine in the room of the late M. Luys.

THE Paris Society of Anthropology offers in 1898 the Brocca prize (1,500 fr.) for a work on Somatology, and the Bertillon prize (500 fr.) for a work on Demography.

THE steamship *Belgica*, carrying the Belgian Antarctic expedition, has, it appears, grounded on an island near Cape Horn, which will prevent the expedition proceeding to the far South this year.

DR. NANSEN left London on April 23d for St. Petersburg, where the Geographical Society will hold a reception in his honor and listen to an address by him. Dr. Nansen will next proceed to Vienna to lecture before the Geographical Society of that city and receive its Hauer Medal. He will also lecture in Budapest and Pressburg.

HERR KRUPP, of Essen, who has recently made a number of gifts for educational and scientific purposes, has presented the Berlin Geographical Society with 10,000 Marks for the foundation of a gold medal to be named after Nachtigall, the African explorer, and to be given by preference for discoveries in Africa.

THE Trustees of the Missouri Botanical Garden hold their ninth annual banquet at the St. Nicholas Hotel, St. Louis, to-morrow.

THE United States Civil Service Commission announces that, on June 7, 1898, examination may be taken at any city in the United States where the Commission has a competent board of examiners to establish an eligible register for the grade of expert computer and geodesist. There is at present a vacancy in the U. S. Coast and Geodetic Survey, Treasury Department, at a salary of $2,400 per annum, which it is desired to fill. The duties of the position for which this examination will be held will be partly administrative, but principally they will be in the line of geodetic computations consequent upon the field work of the Survey. Such computations will embrace the whole subject of geodesy and allied subjects, the astronomical determination of latitude, longitude and azimuth; triangulation, magnetic, gravity, tidal, physical hydrography, leveling, deflections of the vertical, etc. The examination will consist of the subjects named below which will be weighted as follows:

Ability and experience in the discussion of geodetic problems and administration of computing work	25
Publications in the line of geodesy, mathematics and astronomy	25
Positions held by the applicant in professional life	25
Answers to questions which will be furnished on examination	25
Total	100

The Department states that it is desirable that applicants should not be over 35 years of age.

THERE is also a vacancy in the position of nautical expert in the U. S. Coast and Geodetic

Survey, with a salary of $1,800. The examination will be held on the same day and will cover the hydrographic work of the Survey, navigation and knowledge of the lighthouses, buoys and general geography of the Pacific Coast.

The Academy of Natural Sciences of Philadelphia has appointed Mr. Wm. W. Jefferis special curator of the William S. Vaux collection for the current year. The following have been appointed the committee on the Hayden Memorial Geological Award: Messrs. Persifor Frazer, Angelo Heilprin, Theodore D. Rand, Benjamin Smith Lyman and J. P. Lesley. The award consists of a bronze medal and the balance of the interest arising from the endowment fund and is conferred annually for the best publication, exploration, discovery or research in the sciences of geology and paleontology, or in such particular branches thereof as may be designated. The recognition is not confined to American naturalists and has been granted as follows: 1890, James Hall; 1891, Edward D. Cope; 1892, Edward Suess; 1893, Thomas H. Huxley; 1894, Gabriel Auguste Daubrée; 1895, Karl A. von Zittel; 1896, Giovanni Capellini; 1897, A. Karpinski.

The Geographical Society of Philadelphia held its annual meeting and reception on May 4th. Professor Angelo Heilprin, the retiring President, delivered an illustrated lecture on 'A Winter Trip to the Grand Cañon of the Colorado.' The annual election of officers resulted as follows: President, Henry G. Bryant; Vice-Presidents, Amos Bonsall, Dr. Daniel G. Brinton; Recording Secretary, Dr. Paul J. Sartain; Corresponding Secretary, Edwin S. Balch; Treasurer, Miss Mary Blakiston; Directors, Professor Angelo Heilprin, Miss E. E. Massey, George G. Mercer; Reception Committee, Miss Ida Cushman, Mrs. J. B. Lippincott, Mrs. Charles Roberts, Miss Rachel Sweatman; Excursion Committee, Miss Mary S. Holmes, Miss Maude G. Hopkins, Charles S. Welles, Dr. H. Emerson Wetherill.

An International Committee has been formed for the purpose of collecting an endowment fund in memory of the late Edmund Drechsel, professor of physiological chemistry at the University of Berne, Professor R. H. Chittenden, of Yale University, being the American representative. As we have already stated, it is wished to mark with a memorial stone the burial place of Drechsel at Naples, and to secure a fund for the education of his sons. Contributions, which, it is hoped, will in some cases take the form of an annual contribution for five or ten years, should be sent to the '*Deutsche Depositenkasse A*,' Berlin W., Mauerstrasse, account of Professor Tschirch for the Drechsel-Endowment, or to the Treasurers of the local committee at Berne, Professor Tschirsch, dean of the faculty of medicine, or Professor Kronecker, director of the physiological institute.

Mr. Alfred V. Allen, of Bath, died on March 24th, at the age of 64 years. We announced recently the discontinuation of the *Journal of Microscopy and International Science*, of which Mr. Allen had been editor since 1882.

Nature announces the death of Dr. John Shearson Hyland, F.G.S., at the early age of thirty-two. The second son of Captain P. Hyland, of Great Crosby, he was educated at the Merchant Taylors' School, at University College, Liverpool, and subsequently at Leipzig. At the University of Leipzig he studied mineralogy and petrology under Dr. Zirkel, and took the degree of Ph.D., his thesis being entitled 'Ueber die Gesteine des Kilimandscharo und dessen Umgebung,' and published in 1888. In the same year he joined the staff of the Geological Survey, and was for three years occupied in the Irish branch in investigations on the eruptive rocks of the country. During this period he published several papers on petrological subjects and gave great promise of a brilliant career. Being of an active, enterprising nature, he relinquished the work of the microscope, and, throwing up his post on the Geological Survey, took to the more practical work of reporting on mineral resources in the United States, subsequently in British Central Africa, and finally on the treacherous west coast of Africa, where he died at Elmina on April 19th.

From the *Chemist and Druggist*, *Nature* quotes the following details regarding the late Dr. J. G. N. Dragendorff, for many years Director of

Pharmaceutical Institute at Dorpat, in Russia. Dr. Dragendorff was born in Röstock in 1836. After qualifying as an 'apotheker,' he studied chemistry in the Heidelberg University, which he left in 1860 to become assistant to Professor F. Schultze in the chemical laboratories of the Rostock University. In the same year he graduated as Ph.D., his thesis being on the action of phosphorus upon some carbonates and borates. In 1862 he went to St. Petersburg to take charge of the *Pharmaceutischen Zeitschrift für Russland*, as editor, and of the laboratories of the Pharmaceutical Society there. While acting in that capacity his reputation grew, and his appointment as professor of pharmacy and Director of the Pharmaceutical Institute at Dorpat in 1864 was the beginning of thirty years' work which made the Dorpat Institute famous all over the world, for Dragendorff's skill as a teacher and discoverer of talent brought students to him from all quarters. He retired to his native town in 1894, and devoted his leisure to a monumental work on medicinal plants, of which at least one part has been published. He was best known to English pharmacists through his 'Plant Analysis,' a translation of which, by his former pupil, Henry G. Greenish, was published in 1883. His work on alkaloids was, however, that by which he is most entitled to fame. The mydriatic alkaloids were his special field, and his syntheses of conine and atropine are amongst the most brilliant achievements of modern chemistry. In 1885 the Pharmaceutical Society of Great Britain conferred the third Hanbury medal upon him.

SUFFICIENT advance subscriptions have been guaranteed to encourage The Open Court Publishing Company in proceeding with its plan of publishing the series of large-sized portraits of philosophers and psychologists, to which we called attention some time since. The first instalment of the portraits, containing the names of Thomas Aquinas, Bacon, Hobbes, Descartes, Spinoza, Locke, Hume, Leibnitz, Wolff, Kant, Schopenhauer, Spencer and others, is now nearly ready.

THE Smithsonian Institution has issued a list, compiled by Mr. W. J. Rhees, of its publications available for distribution. These publications are in many cases of great scientific value and are sold at very low prices. This list of publications, for example, extends to 29 pages and may be secured for two cents. The publications of the Smithsonian Institution consist of: 1, Contributions to Knowledge; 2, Miscellaneous Collections; 3, Annual Reports; 4, Special Papers. The publications include 1,091 separate titles, but many of these can no longer be supplied.

THE work on determination of sex, by Dr. Leopold Schenck, Director of the Embryological Institute of Vienna, of which the newspapers have had so much to say, is announced for immediate publication by Messrs. Schallayin and Wollbruck, Vienna and Leipzig. The title of the book is *Einfluss auf das Geschlechtverhältniss*, and the price will be 3 Marks.

THE museum at Nantes has been enlarged by the addition of a new hall, and special efforts are being made to represent as completely as possible the fauna, flora and geology of western France.

EFFORTS are being made to collect £2,500 to repair the museum building at Barras Bridge, Newcastle, and several subscriptions have been received, including £500 from Lord Armstrong, President of the Natural History Society of Northumberland, Durham and Newcastle, under the auspices of which the museum is conducted.

THE Royal Photographic Society has opened the international exhibition at the Crystal Palace, London, the arrangements for which we have already announced.

THE third annual Congress of the Southeastern Union of Scientific Societies, whose President is the Rev. T. R. R. Stebbing, will be held at Croydon, England, on June 2d, 3d and 4th. Professor G. S. Boulger will deliver the annual address as President-elect.

A MEETING of the Fellows of the Royal Botanic Society, London, was held on April 23d in the Museum at the Society's gardens, Regent's Park, Mr. G. W. Bell presiding. Dr. Coode Adams delivered a lecture on 'Some Remarkable Cacti,' illustrated by lantern slides and

colored drawings, and some living specimens from the large collection possessed by the Society.

AN Association of Medical Librarians was organized at a meeting of a number of representatives of medical libraries held at the editorial rooms of the *Philadelphia Medical Journal*, in Philadelphia, on May 2d. The officers elected were: President, Dr. George M. Gould, of Philadelphia; Vice-President, Dr. J. L. Rothrock, of St. Paul, Minn.; Secretary, Miss M. R. Charlton, of Montreal, Canada; Treasurer, Dr. William Browning, of Brooklyn, N. Y.

JOHN GUITERAS, professor of pathology in the University of Pennsylvania and an eminent yellow fever expert, has been instructed by the Surgeon-General of the United States Army to proceed to Tampa, Florida, to act as medical adviser to the commander of the army which it is expected will invade Cuba. Relative to the dangers which may beset troops in Cuba, and the precautions which should be adopted, the following statement, says the *Philadelphia Medical Journal*, is attributed to Dr. Guiteras: "It is possible to prevent the infection of military garrisons, though whether it can be done in a campaign remains to be seen. Yellow fever is circumscribed within certain areas, and if it is possible to keep troops away from those areas there will be little danger of infection. Contrary to the prevailing idea, altitude does not govern the disease. There are no extremely high altitudes in Cuba, and yet there are places where there is no yellow fever. In some places on the coast the disease is not to be found. As a general rule the more important the town, the greater its commercial activity, the more infected it is. Yet a congregation of people in the interior could not originate yellow fever. The cities where the disease prevails are infected because they are permanently inhabited by a crowd. Still the disease may be carried to a garrison from an infected town. To guard against this the troops must be placed by themselves, in uninfected places, and they must not communicate with infected places. Then, too, no depot of supplies should be placed in an infected port. This is, of course, a desideratum that it may be difficult to obtain for strategic reasons. Ideal conditions are not always possible in a military campaign. Whether or not yellow fever can be kept from the troops depends entirely upon whether these plans can be carried out."

UNIVERSITY AND EDUCATIONAL NEWS.

COLONEL JOSEPH M. BENNETT has given the Trustees of the University of Pennsylvania real estate valued at $80,000, and adjacent to the building he had previously given to the University for a Women's Hall. It is expected that there will ultimately be erected on this land a special building for the women's department of the University, though the buildings as they now exist are available for this purpose. Women are at present admitted to the graduate courses of the University of Pennsylvania, and it is planned to establish undergraduate courses. Colonel Bennett had also previously given to the University $17,500 for fellowships for women, and the announcement is just made that a fellowship for three years has been guaranteed by former women students of the University.

AT the last meeting of the Trustees of Columbia University it was decided to call the building erected for work in physics 'Fayerweather Hall,' in recognition of the bequest of $300,000 made to the University by the late Mr. Fayerweather.

THE University of Edinburgh has received a bequest by the will of the late Honorable B. F. Primrose of £2,000, one half to be used for the encouragement of original research and one-half for the library.

THE diploma of M.D. of the Paris University will henceforth be given to foreign students who go through the medical curriculum without previously passing their *baccalauréat* examination. This diploma, in accordance with Article 15 of the Decree of July 21, 1897, does not give any of the privileges attached to the real degree. It happens curiously that at the same time the Prussian government has adopted an exactly opposite policy and has decided that, after this year, the degree of M.D. will be given to no one who has not passed the state examination and so become legally qualified to practice medicine in the German Empire.

HEINRICH RIES, PH.D. (Columbia), has been appointed instructor in economic geology in Cornell University.

PROFESSOR J. H. WELLS has been appointed professor of mechanical engineering in the University of Montana.

DISCUSSION AND CORRESPONDENCE.

A 'CENTURY OF GEOGRAPHY IN THE UNITED STATES.'

TO THE EDITOR OF SCIENCE: In the preamble to his address entitled a 'Century of Geography in the United States' (this JOURNAL, April 22, 1898) Mr. Marcus Baker states that he proposes to give 'a general review of the century's progress in the diffusion of geographic knowledge in and as to the United States.' For his material he looks 'not to the repulsive black volumes that have for years been poured out over the country from the government printing office,' which represent the *increase*, but 'to text-books, to public addresses in Congress and out, to newspaper and magazine articles, and to public lectures,' which represent the *diffusion* of geographic knowledge.

While it would thus appear that Mr. Baker had intended his address to be of a popular rather than of a scientific nature, yet this does not justify him in making misleading or incorrect statements in regard to the sources from which his geographic knowledge is derived. Such statements are even more liable to do harm in popular addresses than in scientific ones, for the reason that his hearers are less likely to verify them by reference to the original sources of information.

I beg to call the attention of your readers, therefore, to certain of these inaccuracies and misleading statements that have attracted my notice.

1. Powell's first voyage through the canyons of the Colorado was not made in the same year that Alaska was purchased, but two years after, or in 1869.

2. The statement that, at the time the U. S. Geological Survey undertook the gigantic task of making a topographical map of the entire United States, 'topographic maps did not exist,' except of 'a fringe of lake and seacoast,' is not only misleading, but does injustice to the work of the earlier organizations, without essentially enhancing that of the present, to which Mr. Baker is now attached. The earlier topographical work which Mr. Baker ignores includes nearly 90,000 square miles in a belt extending entirely across the Cordilleran system mapped both topographically and geologically by the 40th parallel survey and an area of about 70,000 square miles in Colorado and adjoining States mapped in like manner by the Hayden survey. While these maps are on a smaller scale, and hence give less detail than those made by the present organization, they have been proved by long test to possess a substantial accuracy commensurate with their scale, and are not surpassed or even equalled by corresponding maps in any part of the world.

3. Finally, while enumerating in considerable detail all the other organizations which have contributed to our knowledge of the geography of the country, Mr. Baker has studiously avoided all mention of the Fortieth Parallel Survey, the first to introduce modern methods of topographic surveying into American cartography and to whose pioneer work all the subsequent organizations have been more or less indebted, as I showed in my address on the 'Geology of Government Explorations,' published in this JOURNAL in January, 1897.

S. F. EMMONS.

COLOR VISION.

MY thanks are due Professor Titchener for his appreciative criticism and reply to my recent paper on Color Vision. He confirms some of my most important points in showing that the number of competitors for the credit of new color hypotheses is even greater than I had supposed. It is reassuring to be told that "The psychologist must know them in the sense that he must know his literature at large. He is no more disturbed by them, however, than is the biologist by the thousand and one theories of heredity and transmission that have been formulated since the days of pangenesis."

I am quite willing to be corrected by so competent a psychologist if I was mistaken in thinking that Wundt's hypothesis has a good follow-

ing among psychologists; and, also, if I ascribed to physicists generally some knowledge of the Hering hypothesis. It would, perhaps, have been a more nearly accurate statement to say that most, if not all, of the physicists who are acquainted with Hering's hypothesis reject it. My own acquaintance with the outlines of this hypothesis began sixteen years ago; but Professor Titchener is entirely correct in the conclusion that I have not 'followed up the Hering theory in its meanderings through a large number of scattered journals, some of which are now not at all easy to procure.' I do not consider this remark at all 'blunt,' nor is there anything in Professor Titchener's paper that calls for excuse. I may, however, regretfully remark that, in common with others of my profession, I shall hardly have the opportunity to look up these journals. When a psychologist of recognized authority informs me that 'there are now only two discussable theories of color vision, those of Helmholtz and of Hering,' I am willing and glad to accept his judgment, and to let the rest go with but little attention.

The conflict between these two hypotheses will, therefore, be watched in future years with the calm interest of an outsider, rather than that of a partisan. In teaching that portion of optics which relates to color I shall carefully limit myself to the physical facts; and if Hering's hypothesis should win its spurs, and thus be changed into Hering's theory, the physicists will doubtless forget their ancient hardness of heart and will welcome the settlement of a long vexed question.

Apart from Professor Titchener's discussion, several private communications have brought the assurance that my criticism of the color hypothesis which has for many years held a place in my regular course of instruction has had more than one sympathetic reader. The good spirit which has characterized the reception of my paper is a source of gratification.

W. LE CONTE STEVENS.

THE GEOLOGICAL AND BIOLOGICAL SURVEYS OF ALABAMA.

TO THE EDITOR OF SCIENCE: In his Presidential address, published in SCIENCE, April 29th, Professor V. M. Spalding credits the Biological Survey of Alabama with the botanical work of Dr. Charles Mohr, of Mobile. That Survey is doing most excellent work, but Dr. Mohr has for many years been engaged, under the auspices of the *State Geological Survey*, in the investigation of the Botany of Alabama. As one of the results of this work we have now going through the press a complete flora of the State, and this will be followed by a companion volume in which the useful and noxious plants will be treated in a very thorough manner, as all who know the character of the work of Dr. Mohr will be ready to believe.

The Geological Survey began this work many years before the Biological Survey was inaugurated.

EUGENE A. SMITH.

UNIVERSITY OF ALABAMA, May 6, 1898.

SCIENTIFIC LITERATURE.

An Elementary Course of Infinitesimal Calculus. By HORACE LAMB, M.A., F.R.S., Professor of Mathematics in the Owens College, Victoria University, Manchester; formerly Fellow of Trinity College, Cambridge. Cambridge, University Press. 1897. Crown 8vo. Pp. xx + 616.

The English text-books on the Infinitesimal Calculus in common use afford a formal treatment of the calculus that is all that can be desired. A student who has worked all the examples under important topics in one of these books has been through a course of shop-work that prepares him adequately for the manipulation of calculus formulas—and for the tripos examination. But he has done only shop-work. He has learned to differentiate explicit functions and to integrate (some) explicit functions, and to prove all sorts of things by Taylor's Series. He has *not* been trained to examine carefully the reasoning he employs or to consider even the broadest limitations in the statement of theorems. Teachers of elementary calculus are only too prone to leave the consideration of all such matters to the indefinite future; but a wise system of instruction will strive not to hide from the student, but to point out to him those difficulties that are inherent in the fundamental

conceptions and methods of the science, and to provide him with the simplest means known at the present time for dealing with them.

Professor Lamb has produced a text-book the distinctive feature of which, to our mind, is that a serious and successful attempt has been made to meet these latter demands. The author says: "Considerable attention has been paid to the logic of the subject. Writers of text-books, however elementary, cannot remain permanently indifferent to the investigations of the modern Theory of Functions (of a real variable), although opinions may differ widely as to the character and extent of the influence which these should exert. It is not claimed that the proofs of fundamental propositions which are here offered have the formal precision of statement which is *de rigueur* in the theory referred to; but it is hoped that in substance they will be found to be correct. Occasionally, where a rigorous proof of a theorem in its full generality would be too long or intricate, it has been found possible by introducing some additional condition into the statement, to simplify the argument, without really impairing the practical value of the theorem." In this important respect the book is the first of its kind on the subject of Calculus to appear in the English language. May future writers on Calculus emulate the example of Mr. Lamb in trying to make their presentation rigorous according to the highest standards of their day, and at the same time not beyond the comprehension of the students whom they would instruct!

The choice of material is varied and comprehensive. Both the indefinite and the definite integral are introduced at an early stage. There is a chapter of 44 pp. on Physical Applications and one of 62 pp. on Special Curves, besides an earlier chapter of 47 pp. on Geometrical Applications and a later one of 62 pp. entitled Curvature and containing, among other things, a treatment of the instantaneous center and of the space and body centrodes, including an application to teeth of wheels. Then follow chapters on Differential Equations of the first and second orders (34 + 51 pp.). In order, however, to deal with some of the most important differential equations that arise in practice, some knowledge of the properties of power series is indispensable; and so a chapter on Infinite Series (25 pp.) is introduced. This is one of the first elementary treatments in English of the continuity of infinite series and of the conditions under which they can be integrated and differentiated term by term. It is decidedly well done, and the collection of examples at the end is a valuable contribution to the presentation of this important subject. The book ends with a chapter on Taylor's Theorem.

This is not the place for detailed criticism. We cannot refrain, however, from deploring, especially in a book characterized in the main by rigor, the utter inadequacy of the treatment of the important subject of infinitesimals. As one of the consequences of this neglect, a satisfactory definition of the differential is impossible. Again, some of the applications of the calculus to geometry might have been dispensed with to make place for a somewhat fuller treatment of multiple integration. An unfortunate lapse occurs in the foot-note on p. 544. The power series has not been proved 'uniformly convergent for values of x ranging up to a, exclusively.' The text to which this note is appended is, however, clear and accurate.

The author tells us that "this book attempts to teach those portions of the Calculus which are of primary importance in the application to such subjects as Physics and Engineering." For the vast majority of the students of the calculus their interest is quickened and their insight into the nature of the calculus is deepened if they are shown the applications of analysis to the problems of every-day life. We could wish that the author had laid more stress on such problems, had not a most excellent book representing this side of the calculus recently appeared from the pen of Professor John Perry.* Mr. Lamb's plan, however, is a different one. He says himself: "It is to be clearly understood, indeed, that the object aimed at in this book is not to teach Dynamics or Physics or Engineering, but to exercise the reader in the *kind* of Mathematics which he will find most useful for the study of those subjects."

* *The Calculus for Engineers*, Edward Arnold, London, 1897.

We recommend the book as valuable to the student of physics and engineering, but as especially valuable to the student of pure mathematics, and as a book that will be useful to all teachers of the infinitesimal calculus.

W. F. OSGOOD.

HARVARD UNIVERSITY, 26 April 1898.

A Text-Book of Botany. By DR. E. STRASBURGER, DR. FRITZ NOLL, DR. H. SCHENCK and DR. A. F. W. SCHIMPER; translated by H. C. PORTER, PH.D. London and New York, Macmillan & Co. With 594 illustrations, in part colored. 8vo. Pp. x + 632. $4.50.

In 1894 the 'Bonn Text-Book' appeared from the hand of the brilliant German botanist Strasburger, with the assistance of three of his collaborators. In this volume Strasburger prepared the chapter on external and internal morphology (132 pp.), Noll the chapter on physiology (125 pp.), Schenck that relating to cryptogams (104 pp.) and Schimper that on phanerogams (264 pp.). The success of this volume was so great that in but little more than a year a second edition was brought out, with some new matter and additional illustrations. About a year ago the welcome announcement was made that Dr. Porter, of the University of Pennsylvania, was bringing out a translation of this second edition, but its appearance has been much delayed, and the volume was not issued until early in April of the present year. The length of this delay is indicated by the date of the translator's preface, February, 1896, and accounts for the fact that some important additions to botanical science are not noticed in this otherwise very modern book. There is no reference to Harper's proof of the fecundation in the Erysipheæ, nor to the discovery of antherozoids in lower gymnosperms.

The volume in its German dress is so well known to botanists that it is quite needless to speak of its merits. Perhaps no man living is better prepared than Dr. Strasburger to undertake the presentation of the portion of the work which deals with the internal morphology of plants. Certainly no man has a better knowledge of the structure of the cell, and the many changes which it undergoes in constitution and form. This book, unlike many other text-books, is, in this chapter at least, authoritative.

The translation is good, and the publishers have spared no pains to make the type and printing all that could be desired, these being far more pleasant to the eye in the translation than in the original. The colored figures, also, are somewhat improved by a softening of the rather bright colors of the German editions.

The publishers announce an early issue of this work in two volumes, of about 300 pages each, to be sold separately, volume I. containing Strasburger's chapter on Morphology, and Noll's on Physiology, and volume II., Schenck's Cryptogams and Schimper's Phanerogams. This will be a great improvement, since it will enable the student of morphology and physiology to supply himself with the part relating to these subjects at much less expense.

CHARLES E. BESSEY.

SCIENTIFIC JOURNALS.

Journal of Physical Chemistry, April. 'Study of a three-component System:' by HECTOR R. CARVETH. A study of the freezing-points of lithium, sodium and potassium nitrate mixtures and their classification and interpretation according to the Phase Rule. The suggestion is made of the possibility of applying the freezing-point method to the analysis of mixtures of inorganic salts. 'Note on Thermal Equilibrium in Electrolysis:' by D. TOMMASI. The effect of the simultaneous action of an oxidizing and a reducing agent upon a substance capable of being oxidized or reduced. A mixture of electrolytic hydrogen and oxygen was allowed to act on various substances, as nitric acid, potassium chlorate, etc. The laws are deduced that when a substance is submitted to two equal and contrary chemical actions the reaction which evolves the most heat will take place in preference, provided always it can begin; and of two chemical reactions that one which requires less heat to start it will always take place in preference, even though it evolves less heat than the other reaction. 'Benzene, Acetic Acid and Water:' by JOHN WADDELL. An investigation of the distribution ratio of acetic acid in benzene and water as solvents.

'A Constant Temperature Device:' by HAMILTON P. CADY. A device for keeping up the circulation of water at a constant temperature. 'The Equilibrium of Stereoisomers, II:' by WILDER D. BANCROFT. A study of the change from one isomer into another due to the addition of one or more components. Reviews of books and journals.

American Chemical Journal, May.—'A Determination of the Atomic Weight of Praseodymium and Neodymium:' by H. C. JONES. The material for this work was obtained from the Welsbach Light Co., and was carefully purified and tested with the Rowland spectroscope. The sesquioxide was converted into the sulphate and the calculation made from this. The values obtained were for the Praseodymium 140.45, and for the Neodymium 143.6. 'Veratrine and some of its derivatives:' by G. F. FRANKFORTER. A careful study of this substance and some of its derivatives has shown that it is identical with cevadine. 'On the action of Hydrogen Sulphide upon Vanadates:' by J. LOCKE. Several sulphovanadates have been prepared by the action of hydrogen sulphide on vanadates heated in a combustion furnace. 'On the formation of Imido-1, 2-diazol Derivatives from Aromatic Azimides and Esters of Acetylenecarboxylic-acids:' by A. MICHAEL, F. LUHEN and H. H. HIGBEE. 'On the Oxide of Dichlormethoxyquinonedibenzoyl-methylacetal:' by C. L. JACKSON and H. A. TORREY.

J. ELLIOTT GILPIN.

Appleton's Popular Science Monthly for May gives as a frontispiece a portrait of Professor Russell M. Chittenden, the eminent physiological chemist of Yale University, together with a sketch of his life and work. There is an elaborately illustrated article on 'Kite Flying in 1897,' by Mr. George J. Varney, based chiefly on the work of the Blue Hill Observatory. Dr. J. W. Spencer contributes an article on 'The West Indian Bridge between North and South America;' Dr. H. Carrington Bolton an article entitled 'A Relic of Astrology,' and Messrs. W. H. Beatley and G. H. Perkins an illustrated study of snow crystals. There are further two articles on the study of children and two on economic subjects.

McClure's Magazine for May devotes an article to John Milne, the author being Mr. Cleveland Moffett. There are numerous illustrations, including a portrait of Professor Milne, of his house at the Isle of Wight, and of seismographs and seismograms. Many details are given regarding the earthquake observatory and Professor Milne's experiences, put largely in the form of an interview.

SOCIETIES AND ACADEMIES.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

April 19. Mr. F. J. KEELEY exhibited microscopic preparations of jade from Mexico. The mineral resembles nerphite and is therefore merely a variety of serpentine.

MR. H. A. PILSBRY described the radula of *Nerita peloronta.* It is over two inches long and is in extreme disproportion to the small snail bearing it. Types of rhipidoglossate and other radulæ were described. He regarded the radula of cephalopods not so much as a rasp as a help to swallowing food. In *Limnea* and other gastropods it certainly acts as a rasp. In *Bulla* and other Tectibranchs the structure of the gizzard makes rasping function of the radula comparatively unnecessary.

MR. D. S. HOLMAN made a communication on the keeping of aquaria and described filaments of Spirochætæ an inch or so in length occuring in a pellicle on the surface of a tank partially shaded from the sun.

The PRESIDENT exhibited a pearl from a little neck clam. It is about ⅝ of an inch in diameter, the shades of color resembling an eye, the optic nerve being suggested by a projection at the back. The inside of the shell was devoid of coloring matter.

April 26th. DR. A. F. WITMER made a communication on the training of chronic epileptics, dwelling on the pathology of the disease and the advantages derived from fixing the attention by means of work on perforated embroidery cards with colored silks.

DR. BENJAMIN SHARP spoke of rock carvings occurring on the west side of Kauaii, one of the Sandwich Islands. The carvings are on rocks usually covered to a considerable height with beach sand and can only be seen when de-

nuded by peculiar conditions of wind and tide. A correspondent, Mr. F. K. Farley, had recently described such an exposure occurring on June 16th–21th of last year and had sent him illustrations of the carvings, which were exhibited. Mr. Farley describes such portions of the carvings, mostly crude linear representations of the human figure, as could then be seen, estimates the time required to make them and makes suggestions regarding their origin. The speaker, in continuation, presented philological evidence in support of the belief that Hawaii had been visited by Spaniards at an early date.

The distribution of *Fulgur perversum* on the New Jersey coast was commented on by Messrs. Woolman, Pilsbry and U. C. Smith.

May 3d. MR. GEORGE VAUX, JR., prefaced a communication on lead minerals by the remark that at a certain gathering of mineralogists a preponderance of votes was given in favor of regarding Vanadenite and Wolfenite as the most beautiful American minerals, although no one species received a majority of all the votes cast. He then exhibited and described a series of beautiful specimens of lead ores from his private collection and the William S. Vaux collection of the Academy, dwelling on the peculiarities of the examples displayed and giving the localities represented.

MR. JOSEPH WILCOX referred to carbonate of lead from Davidson Co., N. C., and related his unsuccessful effort to buy certain fine specimens from the original owners of the mine, who declined parting with them on the ground that they were all they had secured in return for their investment. Except in the case of mica and corundum, and possibly a little gold, he believed none of the mines of the State had paid their owners.

MR. LEWIS WOOLMAN described and illustrated, by means of microscopic preparations, a number of forms of fossil foraminifera, dwelling on their characters, classification and distribution. Referring to the distribution of fossil *Fulgur perversum* on the New Jersey coast he quoted from Captain Swain, of the Avalon Life Saving Station, that they were found on the beach during a strong northeast wind immediately following a northeast gale.

MR. F. J. KEELEY exhibited under microscopes and commented on a series of specimens illustrating the mode in which organisms are preserved in fossil form. The exhibit included fossil wood, coal, jet, limestone containing shells, a larva in amber, structure of tooth of *Oreodon* and bone of *Iguanodon*, diatoms from Japan, coral, etc.

Papers under the following titles were presented for publication: 'Materials toward a natural classification of the Cylindrelloid Snails,' by Henry A. Pilsbry and E. G. Vanatta; 'Notes on Mr. Meehan's paper on the Plants of Lewis and Clark's Expedition across the Continent, 1804–06,' by Dr. Elliot Coues; 'List of Bats collected by Dr. W. S. Abbott in Siam,' by Gerrit S. Miller, jr.

A paper on the vertebrate remains of the Port Kennedy Bone Cave, by the late Professor Edw. D. Cope, was accepted for publication in the *Journal.* Papers on the summer birds of Central California, by John Van Denburgh, and a revision of the North American slugs, by Henry A. Pilsbry and E. G. Vanatta, will be printed in the *Proceedings.*

EDWARD J. NOLAN,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met April 6th; fifty-seven persons present.

Dr. C. B. Davenport read a paper, 'A precise criterion of species; its applicability to systematic zoology,' and Mr. J. W. Blankinship followed with a paper on 'A precise criterion of species; its application to systematic botany.' These papers will be published in an early number of SCIENCE.

Professor E. S. Morse considered that success in determining the true relations of species would be attained from methods similar to those of Dr. Davenport and Mr. Blankinship. He discussed at length the characteristics of certain land and marine shells of New England and Japan.

Dr. B. L. Robinson said that nutrition in plants was of great importance and rendered measurements of doubtful value; maturity was also of great importance and promiscuous variability should always be taken into account.

Mr. C. J. Maynard said that newer forms

were more plastic than those that had been longer established; he mentioned several cases among shells and birds that could with difficulty be considered by mathematical tests.

Dr. R. T. Jackson alluded to cases among shells showing a radical difference in the right and left sides and to radial variations showing differentiation in a single individual.

Professor Alpheus Hyatt considered that in the papers of Dr. Davenport and Mr. Blankinship opinion was largely replaced by a definite, exact method which should be thoroughly tested. Its applicability would seem confined to characters that can be measured. He doubted if the color characters of the Achatinellinæ could be expressed in numbers.

SAMUEL HENSHAW,
Secretary.

NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY AND MINERALOGY, APRIL 18, 1898.

THE first paper of the evening was by Dr. A. A. Julien on the 'Elements of Strength and Weakness in Building Stones.' Dr. Julien called attention to the fact that in the testing of building stones little consideration is given to the causes influencing their various properties. In judging the resistance which a stone shows towards weathering, care should be taken to recognize the character of the forces to which it has been subjected. The strength of a stone bears no relation to its mineral components, but is dependent on the shape and arrangement of the mineral grains and the character of the cementing material. In considering the strength of a stone four facts have to be kept in mind, viz: interlockment of the particles; coherence, dependent on character of the cement and adhesion of the grains; rigidity; and tension.

The 'quarry sap' he believes, plays a more important rôle than has hitherto been recognized, as it probably carries much of the cement in solution and deposits it only when the stone is exposed to the air. This accounts for the hardening of the stones after being quarried. A distinction should also be made between porosity due to cavities between the grains and interstices in the individual minerals. The former is a source of weakness, the latter not, although either may cause the rock to exhibit a high absorptive capacity.

All these points, which have important bearing on the strength of building stones, are best studied with the microscope. The paper was illustrated by means of sections thrown on the screen with a polarizing lantern. Discussion was by Professor Kemp and Mrs. Dudley.

The second paper of the evening was by J. D. Irving on 'Contact-metamorphism of the Palisades Diabase.' Mr. Irving referred to the work done by Professors Osann and Andrae some years ago and stated that his results agreed with theirs, but recent railroad excavations at Shadyside had enabled him to obtain additional facts. The diabase flow becomes denser, finer grained and prophyritic towards the contact with a decrease in hypersthene. It is also conformable to the Newark shales. In addition to the zones found by Osann, Mr. Irving found: 1. A normal hornfels zone rich in spinel; 2. a hornfels zone with brown basaltic hornblende layers; 3. hornfels with an undeterminable isotropic mineral resembling leucite; 4. hornfels with andalusite becoming more arkose farther from the contact. The diabase is to be considered as an intruded mass and not a surface flow. The paper was discussed by Professors Kemp and Dodge, and Dr. Hovey and Mr. White.

HEINRICH RIES,
Secretary of Section.

CHEMICAL SOCIETY OF WASHINGTON.

THE regular monthly meeting was held on March 10, 1898.

Dr. E. A. de Schweinitz presented a paper on 'The Pasteur Milk Laboratory of Washington.' The speaker first reviewed briefly some of the ways in which milk can become infected, either from the fact that the animals are dirty and the stables in a filthy condition, or from the carelessness of the milkers, the dirty condition of the pans and pails and the use of impure water for washing these utensils. Attention was also called to the fact that dogs, cats, rats, mice, etc., which often obtain access to the place where the milk is ordinarily kept in the country, may affect the milk, as it is well known that these animals are often carriers of disease. In view of all these well known dangers, and es-

pecially the fact that many outbreaks of typhoid fever have been traced directly to an impure milk supply, the Medical Society of the District of Columbia has endeavored to introduce a good milk by appointing a committee that should supervise a dairy and laboratory which was to be conducted on thoroughly hygienic principles. Such a dairy has been established and all possible precautions are observed. The milk is obtained from healthy tuberculin-tested cattle. These are kept in a well-ventilated, clean stable with a cement floor. Before milking the animals are carefully cleaned and curried, and taken into a smaller building designed for a milking room and kept as far as possible free from dust. The milk is immediately passed through a separator and cooled to about 45°. It is then brought to the bottling laboratory in cans, when it is placed in thoroughly clean sterilized bottles, which are sealed with paraffined paper caps. This milk is called sanitary milk, to distinguish it from other milk which is still further improved by pasteur ization. Ordinary milk may contain from 60,-000 to two or three millions of bacteria per cc., whilst by the above method a milk has been obtained which contained only from 1,200 to 3,000 bacteria per cc.

Dr. Hillebrand read a paper on 'The Colorimetric Estimation of Small Amounts of Chromium with Special Reference to Rocks and Minerals.' The time required for the separation of chromium from certain other constituents which have likewise to be determined in rock and ore analysis is very considerable; the amounts in question are often extremely small, and the separations are, therefore, more or less imperfect; hence, a rapid and accurate method for these small amounts is very much needed, and seems to be fully afforded by a comparison of the color of an alkaline solution of the chromium as chromate with a similar solution containing a known amount of chromium. The method was thoroughly tested with prepared chromium solutions whose contents ranged in amounts from 1 mg. to 7.5 mg. counted as Cr_2O_3, in varying dilution, though the figures given by no means represent the limits of the method. The standards employed contained K_2CrO_4, corresponding to .1 and .2 mg. per cc., respectively, of Cr_2O_3, and in making the determinations were always diluted to agree with the purposely made weaker test solutions. The maximum and minimum deviations from the truth were +.32 mg. and —.26 mg.; the average error being a little less than +.02 mg.

The method was given a severe practical test by adding to several grammes of an iron ore, and also to a silicate, known amounts of chromium and subjecting the mixture to fusion with sodium carbonate and potassium nitrate, precipitating P_2O_5, V_2O_5 and CrO_3 from the aqueous extract with mercurous nitrate, igniting the precipitate, fusing the residue with sodium carbonate and thus obtaining a small bulk of highly colored solution. The results were equal to those of the preliminary tests and show the method to be highly accurate for small and moderate amounts of chromium. When there is enough chromium in a sample to give a sufficiently colored extract of the first alkali fusion the color comparison may be made at once with this solution and thus much time may be saved. Maganese, however, must be thoroughly removed, most quickly by reduction with methyl alcohol. The glasses used by the author were shown and the simple precautions for securing proper illumination were described. For amounts less than .1 mg. it is best to use Nessler tubes.

Mr. Tassin exhibited specimens of products obtained in Moissan's electric furnace consisting of carbides of aluminum, boron, iron, cobalt, cerium and calcium, the elements molybdenum, uranium, tungsten, titanium and chromium and a piece of iron containing a diamond. The high temperature which it is possible to obtain with this furnace was illustrated by a specimen of fused lime.

Dr. Bolton presented a postscript to his paper on 'Early American Chemical Societies,' which he read at the meeting held on April 8, 1897. He called attention to a club of German chemists which was organized in New York in the winter of 1863–64. The president of the club was Dr. Friedrich Hoffman and prominent among its members were Ferdinand F. Meyer, M. Alsberg and Isidore Walz.

WILLIAM H. KRUG,
Secretary.

SCIENCE

FRIDAY, MAY 20, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

A PRECISE CRITERION OF SPECIES. *

A. *The General Method.* By C. B. DAVENPORT, Harvard University.

THE aim of this paper is to propose a definite method of judging whether two closely allied and intergrading groups of organisms belong to distinct species or only to subspecies or varieties.

I. *The Present Criteria of Species.* The practical criteria employed at the present time to distinguish a species from a variety are either one of the two following: 1. A certain considerable degree of dissimilarity in characters—of divergence between the types. 2. A sharp demarcation between the types, their mutual isolation, or, in other words, the absence of intergrading forms. Of these two criteria, that of divergence is most generally employed; yet one influential body—The American Ornithologists' Union—adopts the second in a strict form. Its remarkable rule reads: "Forms known to intergrade, no matter how different, must be treated as subspecies; forms not known to intergrade, no matter how closely related, must be treated as full species." This clear cut rule does not seem however to have been worked in practice.† Nearly all naturalists, indeed, recognize a

*Read before the Boston Society of Natural History, April 6, 1898.

† See, for example, the discussion by Merriam, Allen and Roosevelt in SCIENCE, Vol. V., pp. 753, 877 and 879.

certain amount of intergrading between species. What is needed is a method of precisely defining the degree of isolation and the degree of divergence necessary for distinct species.

II. *Method of attaining a Precise Criterion of Species.* We shall accept in what follows the general opinion that the distinction between species and varieties is one of degree of divergence and degree of segregation. The question is always where to draw the line.

In drawing the line between species and varieties we must act somewhat arbitrarily, just because there is no natural division between species and varieties—one shades over into the other. We must, however, have regard to usage—recent usage, on the whole—because species have never before been studied so critically and so extensively as to-day. We must seek to define the position of the line with precision, *i. e.*, quantitatively.

1. *The General Method.* Any adequate quantitative method of studying species must start with the individual. It must recognize that a species is composed of individuals, each differing more or less in any quality from every other individual of the species. The species exist not because all of its component individuals are alike in all respects, but because in certain qualities, such as size, color or form, they tend to group themselves about a certain typical condition, which is at the same time the most frequent condition. We may call it the mode.*

Normally, this tendency for measurements of qualities to group themselves about the mode follows a very definite law. This law is the same as that followed by the deviations of a large number of rifle bullets from the center of the target at which they were aimed. It is known as the Law of Error, and is described in text-books on Least Squares. According to this law the smallest errors are the commonest; the larger ones are rarer, and the errors on one side of the mode are counterbalanced by an equal number of errors of the same size on the other side of the mode. If we lay off at equal intervals on a horizontal line a series of points corresponding to the successive classes of magnitude of an organ, and erect at each one of these points vertical lines proportional in length to the number of cases falling in that class, the curve made by joining their tops will be a normal variability curve (Fig. 1). This curve is a definite one capable of being expressed by a mathematical formula* and of being subjected to further analysis.

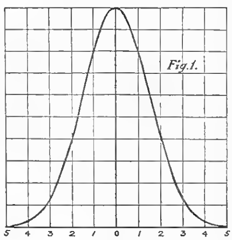


FIG. 1.

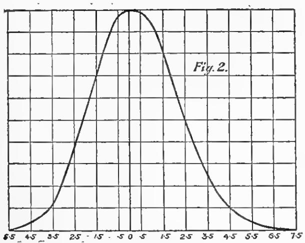
The curve will, however, vary in certain respects with each species measured. Especially will the curve vary in steepness. In some cases 50 per cent. or even more of the individuals will occur in the middle class—at the mode. In other cases 10 per cent. or even less will lie here. In the former case the curve will be very steep—the horizontal distance between the two ends of the curve, the *range*, will be small—the character is somewhat invariable or conservative. In the latter case the range of variation will be very great—the character is, we may say,

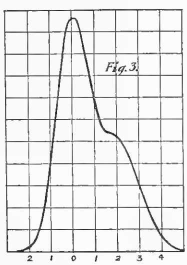
* As Professor Minot has suggested to me, 'center of variation' would be a more suggestive term. Mode has the convenience of brevity.

* The formula is $y = k.e^{-h^2x^2}$, in which k and h are constant for any curve.

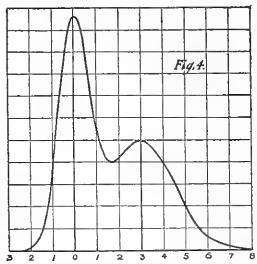
very variable. Thus the variability of any curve will be roughly defined by the range, or when the curve is symmetrical, as is usually the case, by the half-range.*

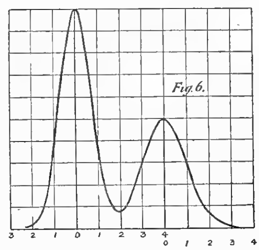
When the relative frequency of the different magnitude-classes gives us the normal curve we may be sure that we are dealing with a single homogeneous group of individuals—a species showing no tendency to break up into varieties, or a pure race. But individual measurements do not always fall into the normal curve. We may get any one of a variety of curves such as are shown in Figures 2, 3, 4, 5 and 6. Figure 2 is an asymmetrical curve. Figures

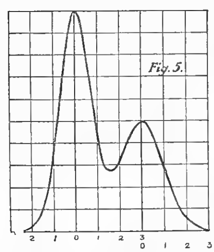




FIGS. 2, 3.







FIGS. 4, 5, 6.

* The half-range is suggested as the measure of variability on account of the fact that its determination requires no calculation. In all cases in which the curve does not end normally, but, on the contrary, includes a few highly abnormal individuals, or in cases of groups lying near the line between species and varieties, it would be best to measure divergence in terms of the 'standard deviation.' This quantity is obtained by first finding the mean of all the measurements, next getting the deviation of each class from the mean, squaring it, and multiplying it by the number of individuals in the class. Add these products, divide by the number of individuals measured, and take the square root of the quotient. These operations are briefly indicated in the formula: standard deviation $= \sqrt{\frac{\Sigma d^2}{n}}$, where Σd^2 is the sum of the squares of the deviations from the mean and n is the number of individuals. When only half of the curve can be used, find the $\Sigma\, d^2$ and n for that half. The standard deviation is normally about one-third of the half range.

4 to 6 are bimaximal curves. All such curves indicate that the material is not homogeneous; that there is a tendency to break up into two races or species with different modes and different indices of variation.

The relationship of the two groups indicated in these curves is not equally close in all. Thus in curve Fig. 2 the two races are hardly separable. In Fig. 6 they appear as distinct, almost completely segregated species. These cases differ both in the degree of isolation and the degree of divergence of the constituent races. We need quantitative expressions for these two qualities.

The degree of isolation may be measured by the depth of the depression between the maxima. By depth of depression we mean the distance of the deepest part of the depression below the level of the lower maximum. This depth may be expressed in per cents. of the length of the shorter mode. It is clear that in Figures 2 and 3 there is no real depression, in Figure 4 one is just appearing; Figures 5 and 6 represent cases of successive increase in the depth of the depression reaching 82% in Figure 6. This ratio of the depression to the length of the shorter mode may be called the Index of Isolation.

The degree of divergence between two groups may be measured by the distance between their modes. This distance must, however, be expressed in a unit independent of the particular units employed in measuring the characters of the species. The unit must be some quality of the curve. The variability of the curve is expressed, as we have seen, by the half-range.* We may use as our unit the average of the two half-ranges of the broader curve when they are both approximately known, otherwise to its outer half-range. The divergence between the races will then be expressed as the ratio of the distance between the modes to the half-range,* or thrice the standard deviation, of the broader curve. This may be called the Index of Divergence.

These two indices, however, are not independent but are curiously bound together. Thus if two equal, symmetrical curves with the same variation overlap so that the inner end of each curve just touches the mode of the other—in other words, when the Index or Divergence, is 100, the Index of Isolation will be found to be about 56. If the curves are of very different area or form, the Index of Isolation may be, with the Index of Divergence still at 100, diminished, but where large numbers are used it will rarely, in practice (provided the curves are symmetrical) be less than 50.

The question arises whether it would not be necessary to draw curves for many characters. Practically it will not be necessary, for confluent species are usually separated chiefly by one most distinctive character. This character may be termed the *chief differential.* It may be used alone to measure the isolation and divergence of the groups, to test their specific value.

Again, how are the individuals which are measured for the differential to be selected? They must be taken methodically at random. This sounds paradoxical, perhaps, but it is not. One takes methodically at random when one lays a yard stick on a grass plot and plucks those blades which lie nearest the inch divisions, or gathers field mice from traps set in a straight line at distances of one mile apart, or at the angles of hundred-mile rectangles, and so on. The individuals measured are rigidly taken on some other basis than their own characters. It will not, of course, always be possible to have individuals gathered so rigidly at random. This is only the ideal which can rarely be realized.

In plotting results the actual and not the percentage frequency of each class should

* Or thrice the standard deviation.

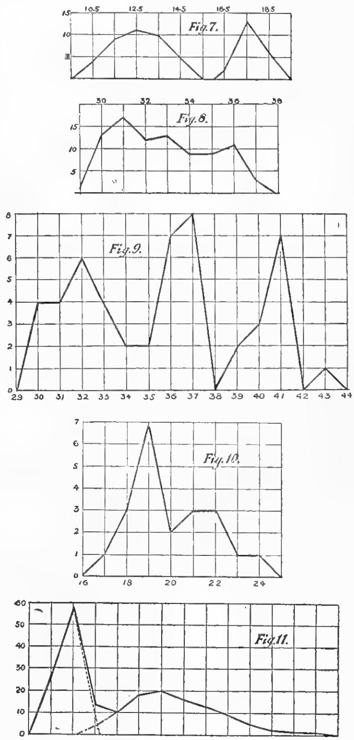
be given. One of the two groups indicated may have many fewer individuals than the other. Very good; this is an important fact which the curve should be left to show.

To sum up: The general method of attaining a precise criterion of species, as opposed to varieties, is to measure the chief differential of the groups, plot the curve of measurements showing the relative number of cases in each class of measurements and determine the index of isolation, or, if more convenient, the index of divergence. If either of these indices is less than a certain number we have varieties; if above that number, species.

2. *Determination of the Line between Species and Varieties.* The question now remains: What is this number below which we have varieties, above which species? To determine it we must, as we have said, have recourse to the usage of systematists.

Let us consider first a clear case: Fig. 7 is formed from measurements of two species of jumping mouse, *Zapus hudsonius* and *Zapus insignis*. 80 individuals of each species, from New Brunswick, New Hampshire, Massachusetts and New York, were measured by Mr. G. S. Miller,* from whose work the data are taken. The two species occur in the same localities. *Zapus insignis* differs from *Z. hudsonius* (1) in having longer ears, (2) in being paler and more fulvous, and (3) in being larger. Numerical data are given on characters (1) and (3) only. These show the length of ears to be the chief differential. Plotting the length of ears, disregarding the very slight sexual differences, we see that there is an absence of intergrades. The index of divergence is 200; that is, the distance between the modes is twice the average distance of the ends of the broader curve from the mode.

Secondly, we have in Figure 8 a curve of three undoubted varieties. The curve is based on measurements of 130 individuals of *Scalops aquaticus*, the Eastern mole, from data furnished by True.* The moles were



FIGS. 7, 8, 9, 10, 11.

collected from (1) the Atlantic and Gulf Slope, (2) the Mississippi Valley as far south as Louisiana, (3) Texas and Oklahoma. In different parts of its range the species shows differences in length of skull and in the form of the coronoid-process of

*G. S. Miller, Jr. A Jumping Mouse, *Zapus insignis*, Miller, new to the United States. Proc. Biol. Soc. Washington., VIII., 1–8, 1893.

*F. W. True, A Revision of the American Moles. Proc. U. S. Nat. Mus., XIX., 1–112.

the lower jaw. Data are given on length of skull, which we assume to be the chief differential. Plotting these data (Fig. 8) we find that they form one curve with, however, three maxima. The index of isolation between the first and second modes is 8% ; between the second and third 18%. The curves from each locality overlap the adjacent modes. The index of divergence is less than 100.

Again we have a case of three alleged species of the mole *Scaphanus* from the extreme northwestern part of the United States. The differentiæ are size of body, color and length of face. Numerical data are given by True on skull length which is closely correlated with the size of the body. The curve (Fig. 9) gives three maxima. The index of isolation between the first and second maxima is 66 ; between the second and third, 100. The end of the constituent curves do not overlap the adjacent modes. The indices of divergence are about 170 and 130 respectively. We may admit these as distinct species.

Again the hare, *Lepus palustris*, varies in different localities chiefly in the breadth of the face. Miller and Bangs * from a study of eight individuals concluded that there were two species which they called *L. palustris* and *L. paludicola*. Later Chapman † concluded from a study of nineteen individuals from the same localities as those of Miller and Bangs that the two forms are only varieties. Which view is correct? Plotting (Fig. 10) the ratio *greatest nasal width*, basilar length of skull, we find that the index of isolation is 33, the index of divergence is 70. These forms are no doubt varieties.

A case from fishes: Two species, *Leuciscus balteatus* and *L. hydrophlox*, from the Columbia River basin differ in the number of rays in the anal fin. The mode of these two groups is different, but an overlapping occurs. Are not these groups perhaps varieties? (Fig. 11.) The index of isolation is 50% ; that of divergence is 100%. The case is a doubtful one. We are near the limit between species and varieties.

Additional examples from mammals, birds and fishes might be given, but those already considered may suffice to illustrate the method by which a conclusion as to where the line should be drawn has been reached for animals. The conclusion is that when the chief differential of any two groups shows an index of isolation of 50% or more, or when their index of divergence is 100% or more, the two groups are species; otherwise they are varieties.

* Proc. Biol. Soc. Wash., IX., 1894.

† Bull. Amer. Mus. Nat. Hist., VI., 341, 1894.

B. *The Chief Differential and Specific vs. Individual Characters.* By J. W. BLANKINSHIP, Harvard University.

IN the previous part of this paper a method was shown for the determination of the value of species by means of the isolation and divergence indicated by the chief-differential. In this will be considered the determination of the chief-differential itself as the most marked of the specific characters, and also the mathematical discrimination of specific and individual characters.

I. *Determination of the Chief-differential.*

Necessarily all the specific characters are considered in the determination of species, but these characters are of different values and their variation from one species into the other is never strictly correlative, hence systematists in the case of critical intergrades are compelled to separate the species by a single character in order to ensure uniformity in their determinations. That character is taken which is most distinct in the two species and exhibits correlative variation with the other, minor, specific characters. That most distinctive character is

here called the chief-differential. Now it is frequently the case that different systematists working in the same groups select different characters as the most distinctive, and consequently, as the characters are not perfectly correlative, the specific line is drawn at different points. For instance, one botanist may separate *Thalictrum purpurascens*, L. from *T. polygamum*, Muhl., by the characters of the leaf, another by the form of the stamens; one distinguish *Callitriche verna*, L. from *C. heterophylla*, Pursh by the persistence of the stigmas; another by the shape of the fruit. It is necessary then to have a method for determining the chief-differential in order that the specific lines be uniformly drawn and that the value of the species be justly estimated. The method for obtaining the chief-differential may be shown by taking a particular case.

Two species of the marsh plant *Typha* are found in the eastern United States and are often confluent at the point where the brackish marshes pass into fresh-water swamps. Seven characters regarded as probably specific were measured in about 250 specimens taken mainly from eastern Massachusetts and selected one meter apart, as nearly as possible, across the swamps were found. These seven characters were each arranged separately by classes, according to size and the relative frequency of each class enumerated, as shown in the following table:

TABLE OF RELATIVE FREQUENCY.

(Fig. 12.) I. STEM-HEIGHT, measured from the ground or water to base of Pistillate Spike.

Decimeters.	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
No. of Individuals.	2	2	6	8	18	30	33	**38**	**38**	27	18	16	7	2	2

(Fig. 13.) II. BASE DIAMETER OF STEM, including leaf-sheaths.

Millimeters.	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
No. of Individuals.	2	20	**45**	21	19	4	10	13	17	**19**	16	13	5	5	2	1

(Fig. 14.) III. MID-STEM DIAMETER, taken at half the height.

Millimeters.	2	3	4	5	6	7	8	9	10	11	12
No. of Individuals.	5	10	**68**	43	29	**31**	25	23	11	2	1

(Fig. 15.) IV. LEAF-WIDTH, largest leaf in widest part.

Millimeters.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
No. of Individuals.	12	26	**39**	25	15	6	5	14	11	16	15	**20**	15	12	7	8	1	1	0	2

(Fig. 16.) V. PISTILLATE SPIKE-LENGTH.

Centimeters.	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
No. of Individuals.	1	0	5	7	9	17	23	22	**37**	**37**	26	23	12	11	6	3	7	1	0	0	1	0	0	1

(Fig. 17.) VI. PISTILLATE SPIKE-DIAMETER.

Millimeters.	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
No. of Individuals.	1	7	3	6	6	12	13	**30**	29	19	3	5	2	10	6	6	16	8	**17**	15	5	10	6	3	1	1	1

(Fig. 18.) VII. INTERVAL between Staminate and Pistillate Spikes.

Centimeters.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of Individuals.	**110**	15	7	16	37	**40**	9	4	2	0	1	1	0	0	0	1

From the table above we may collect the following data:

	Total Variation.	Modes at	Minimum of Sinus.	H'ght of Lower Mode.	Index of Isolation	Divergence of Modes.	Greater half-range.	Index of Divergence.
Stem Height.	7–21 dm.	14–15 dm.	..	..	..	......	......	....
Base Diam.	6–36 mm.	10 & 24mm.	4	19	79	14 mm.	12 mm.	116
Mid-Diam.	2–12 "	4 & 7 "	29	31	7	3 "	5 "	60
Leaf-Width.	4–23 "	6 & 15 "	5	20	75	9 "	8 "	112
Spike Length.	3–26 cm.	11–12 cm.	..	..	.	......	......	....
Spike Diam.	9–35 mm.	16 & 27mm.	2	17	89	11 "	8 "	137
Interval.	0–15 cm.	0 & 5 cm.	7	40	83	5 cm.	10 cm.	50

Of these seven characters the stem-height and the spike-length show no apparent differentiation for the two species; the differentiation is slight in the mid-stem diameter, but is marked in the other characters. Both isolation and divergence are greatest in the spike-diameter, which therefore should be taken for the chief-differential. The isolation being above 50 per cent. (89) and the divergence above 100 per cent. (137), both are undoubtedly good species.

Taking those characters showing marked differentiation, the modes indicate the most frequent form of the species, the smaller size being *angustifolia* and the larger *latifolia*, and hence represent the *specific types* of those species as they occur in this region. This specific type must not be confused with the *historical type*, which is the form of the species first described and may occur at any point within the normal limits of the variation of the species.

II. *Specific and Individual Characters.*

In order to make the enumeration of differentiæ accurate it may be necessary in the discrimination of species to determine which characters can be regarded as specific and which as individual. Those characters are called specific which differ in some respect in the two species and whose difference increases or diminishes correlatively with that of the chief-differential. Any variable character in the two species not exhibiting such correlation is regarded as individual.

In order to determine this fact of correlation, these same characters of *Typha* were compared with the spike-diameter as subject. The average stem-height, base-diameter, leaf-width, etc., was found of all specimens having a spike-diameter of 8 mm., the same of 9 mm., 10 mm., and so on up to 36 mm. Correlation is then shown by the character having a proportional increment or reduction in size in comparison with the chief-differential, the spike-diameter. The result is given in the table below.

From this it appears that the correlation with the spike-diameter is well-marked in the case of the base-diameter, the mid-stem diameter and the leaf-width. It is apparent in the stem-height and spike-length, yet is not so close as to give rise to two modes in the table of frequency. The case of the interval is peculiar. In the table of frequency it exhibits a combined normal and half Galton-curve, while in the table of correlation above, there is little increase or decrease in the first ten numbers (good *angustifolia*) and the subsequent decrease is probably due to intergrading. This character then exhibits individual variation for this species.*

* Of the other characters of *Typha* not here considered, the pollen-grains might possibly prove a better

TABLE OF CORRELATION.

No. Measured.	Spike Diam. mm.	Stem Height cm.	Base Diam. mm.	Mid-Stem. Diam. mm.	Leaf Width mm.	Spike Length cm.	Interval mm.
1	8	115	9	2	4	7	50
3–5	9	100	8	2	3	8	43
7–10	10	100	8	2	4	7	69
5–6	11	105	10	3	5	8	57
11–15	12	110	9	3	4	7	58
11–12	13	124	11	4	5	7	44
23–34	14	117	11	3	5	11	53
29–36	15	130	11	4	6	10	49
46–57	16	140	11	4	6	11	50
37–41	17	141	12	4	7	12	43
30–35	18	173	15	4	8	12	37
15–16	19	153	16	5	10	12	15
18–20	20	169	19	6	11	13	8
7–10	21	153	17	6	10	11	13
36–38	22	168	18	6	11	13	7
22–28	23	163	17	6	10	14	5
24–27	24	158	19	6	11	13	6
33–34	25	155	21	7	13	13	3
17–18	26	159	22	7	13	11	2
33–37	27	168	23	7	14	13	1
23–27	28	170	23	7	15	13	1
9–12	29	175	22	9	15	13	0
15–21	30	172	24	8	15	13	1
11–12	31	162	24	7	14	13	0
6	32	167	24	8	15	13	0
1–4	33	184	23	8	17	11	4
2–3	34	205	25	8	19	18	0
1	35	167	27	9	15	13	0
1	36	142	26	7	13	10	0

A normal curve of variation extends an equal distance on each side of its mode, and hence in a dimorphic curve composed of two such normals the continued extension of the interior curves below the point of confluence may be determined approximately by reference to the exterior halves. In the curve of the spike-diameter (Fig. 17) this overlapping portion of the curves of *latifolia* and *angustifolia* (19–23 mm.) represents the region of intergrades between those two species. Also, the minimum of the sinus (21 mm.), where occur the fewest intergrades between the two species, is the point where systematists would naturally separate them.

It has now been shown that confluent species can be separated by a fixed amount of isolation and divergence, as indicated by their most distinctive character—the chief-differential, which can be determined mathematically by the measurement of all the specific characters; and finally, a method has been indicated whereby specific and individual characters may be distinguished by correlation.

It should be remembered that the measurement of individuals of a species, selected impartially after a fixed method throughout a given region, gives the characteristics of that species—its type and variation, the

differential than any of those measured, but their extremely short duration (about two weeks in the year) and their microscopic size do not render them generally available for systematic work. From my observation of *Typha* in this region, I do not think the color of the spike or shape of the stigmas are reliable as differentials between these two species, and the floral bracts are doubtfully absent in *latifolia*, becoming gradually larger through the intergrades to typical *angustifolia*.

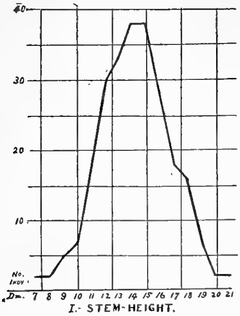


FIG. 12

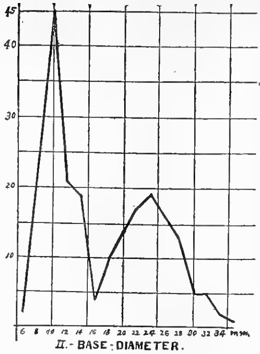


FIG. 13.

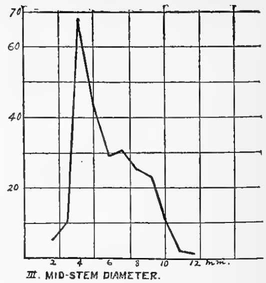


FIG. 14.

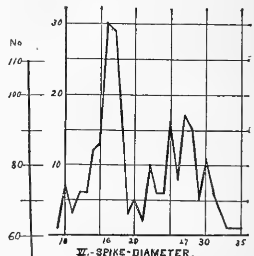


FIG. 17.

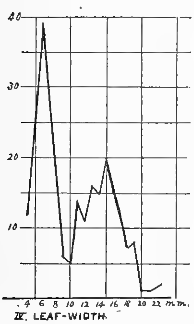


FIG. 15.

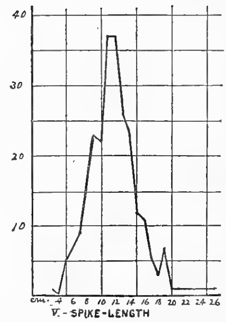


FIG. 16.

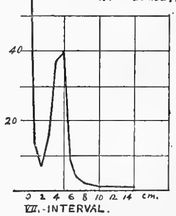


FIG. 18.

relative abundance of its forms and its confluence with allied species—only for that region. For the complete determination of its true characteristics the species must be studied throughout its entire range. This can often be done approximately by the study of a large collection representing the various parts of that range, as is now done in ordinary systematic work. However, two groups found to be so isolated and divergent as to constitute distinct species in any one region where their ranges or specific factors overlap will doubtless be found to continue distinct in all parts of their ranges, as the greatest confluence of such groups is necessarily at points where they occur together.

This method attempts only to express in mathematical terms the facts already recognized by systematists in the discrimination of species; it attempts to determine, by impartial quantitative enumeration of individuals, the specific type and the limits of specific variation, as well as the relative

value of the species or variety, and this more accurately than can be done by the ordinary descriptive terms. The discrimination of species has hitherto been dependent upon the experience and judgment of each systematist, and consequently the results have often been most conflicting and confusing. By the use of a precise mathematical criterion of species 'splitting' and 'lumping' is no longer possible and any hybrid or intergrade, which may have been described as a species or a variety, is clearly shown by its intermediate position and by the absence of isolation, while a sport is indicated by its relative fewness of individuals and its place at the extreme of variation.

The possibilities of statistical methods in the study of individual variation extends far beyond the applications here proposed. The gradual change of the specific type and of the variability of a species, the distinguishing of stable from plastic groups, the influence of environment upon specific form, and many other matters of importance to the philosophical naturalist and systematist, are in the future to be investigated quantitatively.*

* Those who desire further information on the quantitative study of species are referred to the excellent paper of Dr. F. Ludwig: 'Die Pflanzlichen Variationscurven und die Gauss'sche Wahrscheinlichkeitscurve,' in the Botanisches Centralblatt, 73: 241, 1898.

JULIUS SACHS (II).

IT was at Würzburg that Sachs first found fit opportunity to develop his talent for teaching. Too often it happens in lecture-rooms that '*man Viele sieht, die nicht da sind*,' but this did not apply to him. His fascinating, lucid expositions stimulated the students, whilst he knew well how to practically illustrate his subject. He worked incessantly at the materials for demonstrating, drew and painted a number of diagrams, and was constantly adding to his stock of dried plants, alcohol preparations, models and cultures. He considered that all should be in due relation to the subject-matter in a scientific lecture as in the acting of a play. In the winter he lectured on general botany (anatomy and physiology), and in the summer on the 'Natural History of the Plant World.' Besides this he often gave experimental demonstrations in the summer and this necessitated a great deal of work; occasionally he lectured on the history of botany and on the physiological basis of morphology. After 1874 he had a class every term for microscope work.

A great number of botanists worked at one time or another in his laboratory. The first were Dr. Kraus and Millardet (both formerly at Bonn and Freiburg). Among others attracted by him to Würzburg were Baranetzky, Brefeld, Francis Darwin, Detlefsen, Elfving, W. Gardiner, Godlewski, Goebel, Hansen, Hauptfleisch, Klebs, H. Müller-Thurgau, Moll, Noll, Pedersen, Pfeffer, Prantl, Reinke, D. H. Scott, Stahl, Vines, De Vries, Marshall Ward, Weber, Wortmann and Zimmermann. He insisted upon his pupils being in earnest about science, and he brooked no laziness. Weak natures naturally felt his influence most strongly, but he set a higher value on those from whom he could gain something.

With failing health he withdrew more and more into himself. "I am beginning to take private pupils again," he writes, "but there is little pleasure in it. When a professor reaches the age of sixty he ought *eo ipso* to be pensioned off with his full salary; it might be possible to arrange a university that would serve as an almshouse, but I would not go into it."

He urged his pupils to make comprehensive studies even as he was constantly striving after wide generalizations. He was a master in the art. We have only to

think of his 'Experimental Physiology,' his 'Text-book' in four editions, his 'History of Botany' and his 'Lectures on the Physiology of Plants.' Although he wrote with ease, he bestowed great care upon composition, and usually made several rough sketches before the work was done to his satisfaction. In later years he generally dictated, and the 'Lectures' were written in this way. The great debt owed by modern botany to his 'Text-book' can scarcely be appreciated even yet by the younger generation of botanists.

No entirely satisfactory text-book had appeared since Schleiden's 'Outlines,' a book that contained much that was critically suggestive, but, on the other hand, was one-sided and tinged by the author's personal prejudices; nor had the later editions of it been brought up to date with the advance of science. Sachs' book was the first to make Nägeli's and Hofmeister's researches known to the world. It was written in an unusually clear, literary style, and contained all that was best according to 'the present state of science,' as the title page says, especially the author's important physiological researches. The letter-press was interspersed with numerous illustrations, chiefly Sachs' own work and not seldom the results of laborious, tedious experiments. These illustrations have been frequently reproduced and, contrary to Sachs' express wish, have become common property. Too often it has been considered quite unnecessary to obtain his consent to the use of the figures, and the appearance of a newer text-book decked out with his own illustrations elicited from him the somewhat bitter though just remark that a student, using this book, would surely think that he (Sachs) was employed by the author to illustrate his work. Towards the end of his life the frequent revisions needed for a text-book became a burden to him; he could not make up his mind to a fifth edition and he wrote his 'Lectures' in a freer style of exposition.

The book, however, that presents the best insight into Sachs' individuality is his 'History of Botany.' Nägeli had originally been commissioned to undertake this work, which was to form a part of 'The History of Science in Germany,' issued by the Royal Academy of Bavaria, but he had soon abandoned the task. It cost Sachs five years' continuous toil. As with all human work, it has many defects and omissions, but the lucidity, the profound philosophical bent of Sachs' mind, lend an incomparable charm to the whole. An English translation of this work appeared in 1890.

If I further attempt briefly to characterize Sachs' importance with respect to science it is with a due sense of the difficulties of the case. His activity was so comprehensive, the results of his researches have become, through his 'Text-book,' so largely common property that it is not easy briefly to set forth what he has done for science. One would have to write a history of botany from 1860 onwards to justly rate his services. But this is by no means the place for such a work, nor do I feel equal to the task. The extracts already given show that he was no one-sided physiologist, and he was fully aware of the fact. "It may surprise you," he writes, "that from my boyhood the mysteries of relationship (systematic botany) have interested me more than those of biology and physiology. I have apparently specialized in the last-named branch of science, because I have always been of the opinion that the ultimate problems of systematic botany can only be solved by physiological methods." His latest treatises most clearly reveal what he meant.

De Bary's remarks with respect to Mohl apply more or less to almost all distinguished investigators ('Bot. Zeitung,' 1872, p. 572): "As regards a number of dis-

coveries for which we are indebted to Mohl, his claims to priority in them may justly be disputed if this expression be taken to denote the pretension to have first seen or spoken of a thing, * * * the lucid, confident recognition of it is, however, due to Mohl's observation." But in Sachs' case the remark applies not merely to the observation of facts, to which Mohl confined himself, but to bringing into prominence the importance of such facts in their relation to the common stock of our knowledge, and to the right ordering of observations in the general building of knowledge—work on which he laid great stress. He writes: "As I read your book I feel anew how much more merit there is in working out a comprehensive subject from reliable sources, and from a higher standpoint, than in constantly supplying fresh contributions, which, however meritorious in themselves, are yet as the scattered stones of the hillside compared to milestones pointing us on our way!"

Sachs is best known and most famous as the founder of the modern physiology of plants, and his physiological works may be next touched upon. "My earliest treatises," he once wrote, "were composed at a time when the physiology of plants was simply non-existent; I myself was entirely self-taught and consequently much of my work was imperfect, especially the manner of exposition." Nevertheless these earlier works are of great importance. Next to be named come his works upon chemical philosophy. The investigations of Ingenhouss, Th. de Saussure, Liebig, Boussingault and others had supplied the foundation upon which, in connection with the results of plant-anatomy, a more exact knowledge of the phenomena of metabolism was to be built up. It was Sachs who first pointed out "that the starch in chlorophyll is not merely a secondary deposit, but must be regarded as the product of the assimilating activity (produced by the action of light) of the granular, chlorophyll substance; that it is formed in the chlorophyll out of its original elements, and is conducted to the growing buds and to the tissues which store up the reserve material"*—a brilliant addition to our knowledge, the fundamental importance of which needs hardly to be demonstrated at the present day.

The formation of starch largely engaged his attention later on. He contrived a simple means of quantitatively estimating starch-assimilation, and by the application of the 'iodine test' to leaves or portions of leaves, respectively, supplied an extraordinarily simple and instructive method of demonstration.

His services in improving the culture of plants in nutrient solutions are well known. They drew down upon him a violent attack from Knop which deeply wounded him, and not without reason. It is now one of the most elementary experiments in the physiology of plants to rear a plant from germination to seed-bearing by the administration of nutrient salts, but at that time it was maintained that the seed-bearing plants of maize must have been placed in the solution of nutrient salts after they had attained a flourishing condition!

He incidentally discovered the interesting fact that polished marble slabs may be corroded by roots—a fact of some importance for the understanding of the functions of these organs. He began to work upon entirely virgin soil when, at the close of his fiftieth year, he set on foot investigations which brought to light by microscopical tests, and above all by microchemical methods, the movements, chemical changes, and final consumption of the reserve material during the growth of organs. These experiments have also proved of fundamental importance, and he lays stress upon the fact that they served first to lead him to think

* 'Collected Essays,' p. 335.

that the chlorophyll grains are the true organs of assimilation. A bare reference must suffice to the classical treatises on the germination of the date-palm, of grasses, or on inulin, etc.

In later years he ceased to contribute experimentally to our knowledge of metabolism. Other problems had meanwhile claimed his attention. His investigations—the first to be made—into the action of heat claim special notice. The phenomena of freezing had long been in need of investigation, and here also Sachs' work created a clear conception of the problem and went far towards clearing it up. Even more important were 'The Physiological Experiments upon the Dependence of Germination on the Temperature.' For by these the law of the 'drei Kardinalpunkte' (three cardinal points) was established, and the term 'Optimum' introduced for one of them—a name that has been adopted in other departments of science. These experiments were carried out with the simplest appliances not even in a botanical laboratory, but in his own rooms at Prague. His great manual dexterity and skill in devising simple, but extremely effective, instruments were most useful to him.

The discovery that with sensitive organs there are temporary conditions of rigor due to heat and cold has become an intrinsic part of physiology, whilst the establishment of the fact that not only light, but at the same time a sufficiently high temperature, is needed for the formation of cholorophyll in the higher plants was of great interest.

From amongst the series of researches grouped together in the *Gesammelten Abhandlungen* (*Collected Essays*) under the heading 'The Action of Light' I should like shortly to refer to the treatise 'Upon the Influence of Daylight on the Production and Development of Different Plant-organs.'

The fact that the formation of cells and organs is dependent upon light was submitted in this paper for the first time to a searching investigation ; it was shown that the formation of roots was in many cases directly favored by light ; the conclusion was drawn from Wigand's data that with fern prothallia light determines the dorsiventrality, and the phenomena of etiolation, which still present many enigmas, were more closely examined. The investigation into the action of light through the medium of the foliage-leaves upon the formation of flowers was especially important to Sachs, because it formed the starting-point for his later theory of 'Matter and Form.' It showed him that plants, such as *Tropaeolum*, *Brassica*, etc., continue to produce etiolated stem-parts and leaves in darkness "in sufficient quantity for the production of fresh blooms if this depended only upon the bulk of the material stored for the purpose and not also upon the particular quality of it," a fact that later led him to form his theory as to the specific matter out of which organs are formed. The formation of blossoms was proved to depend directly or indirectly upon light, inasmuch as by the assimilating activity of the leaves in light the materials destined to produce flowers are formed. Later research into 'The action of the ultra-violet rays upon the production of flowers' seeks to define this phenomenon more closely.

The action of colored light upon plants in respect to assimilation and to their heliotropic curves, etc., received soon after valuable confirmation. Sachs introduced the simple and convenient method of counting the bubbles given off by water plants in light, and came to the conclusion (which lately has again been questioned) that the so-called chemical rays have very little to do with the giving off of oxygen.

A keen controversy was aroused by the opinions he formed in consequence of his researches into 'The movements of water in plants.' But even if his inbibition

theory be rejected it must not be forgotten how many valuable facts are due to his activity in this field. The effects produced by the chemical and physical state of the soil upon transpiration, the checking action of salt solutions, low temperatures, etc., were well established; the 'Lithium Method' was used for measuring the rate of the transpiration current; and the profound and far-reaching importance of transpiration for the life of most plants was demonstrated.

A further laborious and protracted series of experiments dealt with the phenomena of growth and of movements produced by stimuli. Among the more notable of these are the construction of the first auxanometer, the graphic description of his observations, and the recognition of the grand period of growth. His investigations into the growth of the main and side roots first proved convincingly the factors which condition the regular extension of the root system in the ground, and established the distribution of growth in roots, as well as the correlation between main and side roots. A number of isolated observations are also to be found in this exhaustive treatise. Sachs' clear, perspicuous style renders it a pleasure to read any of his essays, even when he is compelled to enter minutely into detail.

The phenomenon of 'Hydrotropismus' (the name originated with Sachs) had already been occasionally investigated, but Sachs showed it to be due to irritability, demonstrated its importance and facilitated the examination of it by a simple apparatus. The 'Hängende Sieb' (hanging sieve) is now to be found, like the auxanometer and the klinostat, in every botanical laboratory.

The 'Tropisms' (Heliotropism, Geotropism, etc.) made large demands upon his time and attention. When under Hofmeister's influence, as regards experimental physiology, he inclined to an external, mechanical conception of these, but abandoned this later. His own words best denote his standpoint: "I, too, should have nothing to say against the term 'Lebenskraft' (vital force), and have indicated as much from time to time in my 'History of Botany,' but the word has been spoilt and rendered nugatory by misuse. I say, therefore, to denote my conception of the organic world, that the province of true physiology begins where that of mechanics, physics and chemistry of organisms ends. Indeed, I go farther and maintain that the time will come when in physiology will be found the ultimate basis (what Goethe speaks of as 'die Mütter') of all natural sciences." There is no need to say that this vitalistic view did not prevent him from working out with the deepest interest the phenomena of growth-curvatures. He also established the phenomenon known as 'after-effects,' and contributed many other valuable isolated experiments.

If he attached great importance to theories, he was fully conscious of their transitory nature; and I might mention, as an example of this, that in his later years he did not lay so much stress upon his theory of Heliotropism. There will be more to say about this when reference is made to his treatise on orthotropic and plagiotropic organs.

In the meanwhile attention must be directed to the essays upon the connection between cell-formation and growth, which in my opinion belong to his most brilliant achievements. As a result of Nägeli's researches on the apical cell, numerous botanical works had arisen dealing with the laws of cell-division. It was this tendency, exaggerated until it was justly dubbed 'Zellfängerei,' that led men to neglect plants and organs as a whole for the mere cells, and to take it as granted that growth is determined by the manner and method of cell-division, much as the shape of a building

is determined by the way the building-stones are laid one upon another.

Hofmeister's brilliant, though hardly well-grounded, opposition had but little success; only a few botanists took any notice of it. It was Sachs who, in his usual clear manner and by the aid of simple contrivances, first explained the relations between cell-disposition and growth. In his opinion the latter is the determining factor, the arrangement of cells depending upon growth. This explained why, for instance, cross-sections through cylindrical masses of cells in plants belonging to widely separated groups may present the same appearance of cell-arrangement as a developing alga or a hair of a dicotyledon. The introduction of the terms 'anticlinal' and 'periclinal' made a brief, striking bird's-eye view of the matter possible, and facilitated further study of the changes in cell-disposition occurring during growth. A large group of facts was brought together under a common heading, and not only was the way made smooth for further investigations into the causes of the arrangement of cells, but an important point of departure was also made for experiments on the evolution of organs which do not possess an apical cell.

The changes which had gradually taken place in the cell theory have led to an entire alteration in its original meaning. This prompted Sachs, who always felt the need of clear and consequently historically correct conceptions, to introduce the definition '*Energid*.' In my opinion he thereby rendered good service to science. It was a great satisfaction to him that his achievements found favor with the most eminent histologists (Kupffer, for instance), and this consoled him for the fact that the botanists, now as on other occasions, instead of testing the innovation in its general application, sought only too zealously for instances in which it did not apply. But the time will surely come when it will be deemed absurd to describe a *Caulerpa*, for instance, as a 'unicellular' plant, and it fell to Sachs to fit scientific nomenclature to recent advances in knowledge. It was self-evident to him that definitions are only a means towards generalization and that they have absolutely no validity in themselves.

The essay upon orthotropic and plagiotropic plant-parts takes us into a region that lay nearest to Sachs' heart during the last years of his life, namely, that of physiological or causative morphology. In this treatise he deals with the connection between the structure (in the widest sense of the word) and the direction of the organs. The definitions 'orthotropic' and 'plagiotropic' were introduced, and referred more particularly to the dorsiventral structures that had long been neglected under the supremacy of the 'spiral theory.' He does not merely treat of the purely structural conditions, but of the causative relations between orthotropic growth and dorsiventral structure. Sachs would, I believe, have altered later his theoretical conclusions upon plagiotropism; they are based upon ideas which he no longer held, as we may see in the text, to be as thoroughly warranted as formerly. But putting aside these points, about which opinions still differ, we find ideas in this essay that are still working with considerable effect in morphology.

As a morphologist Sachs' activity displayed itself in one direction by some special studies that date from his earlier years, in another by his text-books, and again by his final general essays.

His two treatises, on Collema* and Crucibulum, show him at work in the region of cryptogams. It was he who in his 'Text-book' defended Schwendener's Lichen

*In this essay he approached very closely to the later lichen theory when he said that it looked as if a parasitical fungus had established itself in the nostoc; he believed that the nostoc-heterocysts might develop into a mycellium.

theory at a time when the cautious De Bary (in his criticisms of the second editions of the 'Text-book') looked askance at it. The Archegoniates are treated in the 'Text-book' with special interest, forming part, as they had done, of his own researches. His grouping of thallophytes (in the fourth edition of the 'Text-book'), which met with such adverse criticism, has at any rate attained the satisfactory position of being approached again in our own days by many writers.

Throughout his life he cared little for those details that often fill men's lives, and preferred to view matters from a wide and general standpoint. In the first edition of his 'Text-book' he had set his face against 'idealistic morphology' at a time when it was dominant, and in a paragraph of his 'History' that promises to become classical he laid bare the foundations upon which this tendency rested.

Darwinism was another bugbear to him and he intended to attack it vigorously in the 'Principles.' "As far as it goes I am delighted to be free from 'the immutability of species' and to be able on good grounds to accept evolution. But it is absolutely uncertain *how* we are to conceive of this latter. Therefore, I say that the natural system of classification is only to be explained by descent, but how *this* is to be explained no one knows. I regard descent as a fact, like gravitation, about which also we are absolutely in the dark." His whole conception of the world rebelled against 'the crude materialism' which he thought he found in Darwinism. "If my 'Principles' do not meet with the response I had expected, they have done me good service in showing me that Darwinism as a whole is entirely superfluous for any scheme of the final causes of nature. A superfluous theory has received its sentence."

He sought, however, to obtain some similar conception of causes by his theory of 'organ-forming matter,' which caused the external diversity of organs to appear dependent upon their material differences of substance, a view which had its origin in the researches alluded to above on the dependence of bud-formation upon the assimilation activity of the leaves. By this a theoretical basis was gained for experimental morphology; deformities, galls, etc., could be referred to definite changes of substance; and the assumption that stem-forming substances find their way to the point of stem-growth, root-forming to that of the root-system, explained to him most naturally the facts to be seen in reproduction. It is evident that in such a difficult subject one must look for sketches, or general views, rather than theories worked out in detail. But at any rate Sachs' views are more fruitful than Nägeli's 'Idio-plasma,' and he made a number of experimental morphological studies on their bases.

He had already arrived at the conception of the continuity of the embryonic substance before the appearance of Weismann's 'Germ-plasm.' "That which has maintained itself alive, and has continually reproduced itself since the beginning of organic life upon the earth, moving steadily onward in the eternal change of all structures, in the unvarying alternation of life and death, *that* is the embryonic matter of vegetation, and it is this which in certain cases differentiates itself into the two sexes in order again to unite."

He conceived of the multiplicity of plant forms as arising, on the one hand, from the phylogenetic morphological differentiation (this, however, he regarded as an 'absolute mystery'), and on the other from the reaction of the common vegetable substance in response to external stimuli (automorphosis and mechanomorphosis). 'Adaptation' in Darwin's sense of the expression he considered entirely superfluous, and herein he was in entire agreement with

Nägeli. He expressed his views in a powerful manner in his last writings—the physiological 'Notices'* published in 'Flora.' The manuscript found after his death, entitled 'The Principles of Vegetable Formation,' has been handed over to Professor Noll for publication.

This slight sketch can give but an inadequate idea of Sachs' life-work, with its abundant results as regards science; indeed, I can but liken what I have written to a man striking, one by one, a few strings of an instrument that has answered to the touch of some great musician.

One may well say with the Psalmist in speaking of his days:

> "Yet is their strength but labor and sorrow."

Nevertheless his life has borne rich fruit; his name is forever bound up with the history of botany. He has enriched this science by the discovery of new and important facts and conceptions and by his unrivalled power of clear definition. In the nature of things it is impossible that all his theories should retain acceptance, but they have all profoundly influenced his contemporaries. There is no doubt that in any other calling Sachs would have risen to the first rank; eccentricities and narrow 'specializing' were alike repugnant to him. In the last years of his life he applied himself eagerly to paleontological and zoological studies. "I must be learning, always learning," he wrote in a letter. In spite of his incessant labors, he was one of the few men of the present day who possess the gift of letter-writing and withal a spirited style, clear and trenchant. And yet these letters, written during the last fifteen years of his life, form one long report of illness.

At last Death, who in the latter years had often drawn very near, took him gently by the hand and led him to his final rest.

K. Goebel.

* These will shortly appear as a separate publication.

THE BREEDING OF ANIMALS AT WOODS HOLL DURING THE MONTH OF APRIL, 1898.

The temperature of the water has remained above the average almost throughout the month. During the first week the thermometer registered 41 F. to 42 F.; during the last week, 45 F. to 46 F. The specific gravity has varied from 1.0231 to 1.0235. The weather has been generally cloudy and the temperature of the atmosphere low.

Vertebrates. — The winter flatfish, *P. americanus*, ceased spawning early in the month, and, though the height of the breeding season was in March, few of the young flatfish have been taken, even over the natural spawning grounds. Young sculpin (*A. æneus*) were very abundant in the tow, especially during the first of the month. On April 4th a very large number were captured, and many were taken on the 18th. On the 27th a few more were taken which apparently had just hatched. Small cod and pollock have been frequently captured, and the latter were more numerous than in March. The young of the sand-launce (*A. americanus*) have diminished in numbers but little since last month, though some have increased considerably in size. On the 17th an unusually large number were taken. The young of the fall herring (*A. harengus*), from three-fourths of an inch to three inches in length, have appeared in increasing numbers. A few specimens of *Ctenolabrus* were examined on April 19th, but the sexual glands, though quite large, were not nearly mature. *Petromyzon* has been taken in the fish traps, and may be seen frequently in the markets.

Crustacea.—The small species of *Gammarus*, abundant in the tow during March, are still breeding. Their appearance, from day to day, is uncertain. One day there may be only four or five in the net, and the next day hundreds may be captured. A

small species of *Mysis*, about one-half inch in length, has been abundant, and the brood-pouches have been filled with eggs or embryos. A larger species, bearing well developed embryos, was abundantly taken during the first two or three weeks. The red copepod, the favorite food of the young cod, sculpin and sand launce, has been present in great numbers. A few were caught at every haul of the skimming-net, and frequently great numbers were taken. Their sudden appearance and disappearance is very puzzling. Dr. Loeb has shown that in the aquaria they are positively or negatively heliotropic, according to the temperature, but I find that when first transferred from the surface-net into a dish a large minority become negatively heliotropic, though, of course, all are subjected to temperature of the ocean. Many other species of copepods were caught, though not in great abundance. Some were bearing eggs attached to the abdominal appendages. A small parasitic copepod is very frequently found attached to the young cod, sand launce and sculpin. Perhaps one-third of these fish are thus infested. The *isopod* (*Cirolana concharum*) was not breeding on April 26th, and the associated *amphipod* had apparently passed its breeding season. *Hippa* has not begun to lay, though the ovaries are full of large brilliantly-colored eggs. They have been found breeding in July.

Vermes.—No *Nereis virens* or *Nereis limbata* have been seen at the surface. *Autolytus*, with egg-clusters attached, were regularly taken in the tow, usually three or four at a time, during the earlier portions of the month. Later in the month only a few were noticed. An interesting species of *Syllis* has been taken from among the hydroids and algæ on several occasions. These annelids are in almost every case about to undergo fission. The new head is found in all stages of development in the midst of the trunk metameres. The eyes on the new head are large and brown, while those on the first segment are small and black. These annelids are full of mature eggs, which, in some instances at least, occupy the body-cavity both in front of and behind the new head. A light, cream-colored terebellid, full of eggs, has been taken from time to time, and was also taken during March. It is almost invariably present in clusters of the hydroid *Parypha*, along with one or two species of *Caprella*, *Eolis* and the little gasterpod *Astyris*. *Harmothoe* sp. has commonly been found under stones and among hydroids, laden with beautiful pink eggs, which show clearly through the body-wall. On April 11th the eggs, teased from the body cavity, were easily fertilized, and in less than two hours some had reached the eight-cell stage; specimens taken April 17th were also full of eggs. The common *Lepidonotus* has been laying during the last two weeks. *Cirratulus grandis*, collected at Ram Island, April 9th, and at Pine Island, April 17th, contained great numbers of eggs, apparently nearly ripe, though an attempt at artificial fertilization was not successful. Some of the spermatozoa were motile, but the male worms did not have the bright orange color which characterizes them in the height of the breeding season, early in July. Sagitta, though numerous, has been less abundant than in March. The specimens are much larger than those found during the summer months, and are filled with eggs. During the last week there has been a notable decrease in their numbers, and small individuals, less than one-half inch in length, have been frequently noted.

Mollusks.—A few egg-strings of *Sycotypus* and *Fulgar*, containing well-formed shells, have been taken at various localities along the shore. *Urosalpinx* has not begun to breed. Young ‘veligers’ of *Crepidula for-*

nicata were found in the egg-packets on April 6th and on April 17th, though specimens with young are not frequent. The eggs of a small gasteropod abounded on the stems of *Parypha* during the entire month. Five species of nudibranchs, belonging to the genus *Eolis*, have laid their eggs in the aquaria. The hermaphrodite gland of *Eolis papillosa* contains giant erythrophilous spermatozoa, like those of *Paludina vivipara*, which Auerbach has described. Eggs of *Ilyanassa* were found April 25th and 27th. The 'sand collars' of Natica were found at Hadley Harbor, April 25th.

Echinoderms.—*Echinorachnius parma* has not been examined since the early part of the month, when it was breeding abundantly. On April 16th the plutei, developed from eggs fertilized on March 22d, were still living in the aquaria. Eggs of this species have also been obtained in June and July. It is a remarkable fact that, though neither *Asterias vulgaris* nor *Asterias forbesii* at Woods Holl contain ripe sexual products, those of the latter species in certain parts of Narragansett Bay have been full, almost to bursting, of eggs and spermatozoa since the early part of April. The holothurians *Thyone*, *Leptosynapta giradii* and *L. roseola*, were examined April 24th, and were all full of nearly ripe eggs or sperm. Not the least attractive of the echinoderm eggs are those of the little starfish, *Cribrella sanguinolenta.* This species is not uncommon at Woods Holl, and the eggs, which were frequently laid in the aquaria during the third week in April, are as large as those of *Clepsine* or *Sycotypus.* They develop slowly, reaching the two-cell stage in about 6 hours. This material would undoubtedly be of great value in solving problems of cleavage and of echinoderm metamorphosis.

Cœlenterates.—The profusion of cœlenterate material was a feature of every collecting excursion during the first half of the month. Hydromedusæ of many different species were abundant in the tow until about the 17th of the month, and since then have been caught in small numbers. Among these, *Hybocodon* was perhaps the most numerous, although *Coryne* and *Tiaropsis* has been taken frequently. *Tima formosa*, abundant in 1897 at Newport, has not been seen. Hydroids of the brilliantly colored *Coryne* occurred in colonies that could be measured by the square yard, and those of a species of *Campanularia* could be measured by the square rod. On April 26th the *Coryne* had disintegrated. The large jellyfish, *Cyanea arctica*, has been represented throughout the month by specimens ranging from one-half inch to seven and eight inches in diameter, and *Ephyræ* were caught as late as the 21st. On April 8th the water at Waquoit was full of *Aurelia*, most of the specimens being from one to two inches in diameter, though some were much larger. *Metridium marginatum* was examined on the 18th, and was found to be full of eggs, apparently nearly mature. One of the 'sulphur sponges' was observed to extrude clouds of spermatozoa on April 10th.

The gelatinous alga, so abundant during March and the first half of April, gradually diminished in quantity after the 17th, and on April 25 little or none was found in the nets.*

A. D. Mead.

CURRENT NOTES ON PHYSIOGRAPHY.

THE ORIGIN OF PUGET SOUND.

The long fiords of the submerged mountainous coast of Alaska and British Columbia naturally give rise to the impression that Puget Sound and its many branches in Washington are also drowned valleys. This off-hand interpretation is combated in an essay on the 'Drift phenomena of Puget

* The Breeding of Animals at Woods Holl for the month of March was published in 'Science,' April 8, 1898.

Sound,' by Willis (Bull. Geol. Soc. Amer., IX., 1898, 111–162), who after a study of the region concludes that it was invaded by confluent glaciers from mountains on the north, east and west, and that the spaces between the ice streams were built up by washed drift. Plateau-like land-arms were thus constructed with relatively even upland surfaces and smooth marginal slopes, while the glaciers held possession of the troughs. When the glaciers melted away, the troughs came to be occupied by arms of the sea. Lateral moraines along certain of the troughs prove that they antedate the latest epoch of glaciation, and are not channels of post-Pliocene erosion. The greater depths of certain troughs some distance in from their outer end does not accord with the idea that they are drowned valleys of stream erosion. Since the disappearance of the ice, alluvial deposits brought down by the larger rivers have formed delta flood plains in a number of the troughs, such as those of Duwamish and Puyallup valleys, by Seattle and Tacoma.

THE PLAINS OF RUSSIA.

Das russische Flachland forms the subject of an interesting sketch by Philippson (Zeitschr. Gesell. f. Erdk. Berlin, XXXIII., 1898, 37–68), from which the leading features of that great region may be easily gathered. Paleozoic strata, nearly horizontal and but moderately indurated, rest upon a crystalline floor that appears on the northwest and southwest; Mesozoic and Tertiary strata overlap irregularly, chiefly from the southeast. Bevelling far and wide across these varied formations stretches the upland plain of comparatively even surface at an altitude of 200–300 meters. The northwestern part of the plain is heavily covered with glacial drift, through which the bed rock is seldom seen; the southern part has a loess mantle, which overlaps the border of the drift. The former is the region of forests; the latter, of steppes; the 'black earth' being a modification of loess by the superficial addition of humus. The plain beneath these discrete covers is described as a gigantic 'denudationsflache,' the result of the lateral shifting of great rivers when the land stood lower than now; and the question is raised whether the floods from melting ice fields may not have supplied the great rivers. To-day the plain is dissected by narrow valleys of branching streams, and from this an uplift is inferred subsequent to the peneplanation.

The insular position of Great Britain has been recognized by British geologists and geographers as giving rise to an over-estimate of the relative value of marine as compared to sub-aerial denudation. May not the relatively modern block-dislocations of the uplands and mountains of Germany, where many areas of resistant rocks are included, and where an advanced stage of base-levelling has not been reached in the present cycle of erosion, have given rise to an under-estimate of the competency of normal rivers to produce peneplains. Such general denudation is aided truly enough by the lateral shifting of the larger streams, but it is accomplished chiefly by the slow weathering of the inter-stream hills. Does it not hurry the slow processes of penultimate denudation to imply that they may have been accomplished in so brief an episode as a glacial period, and by so temporary an agent as the floods from a melting ice sheet?

TIDAL PROBLEMS.

The difficulty of accounting for the actual tides of the oceans, in contrast to the ease of explaining the lunar and solar forces to which they are due, is well set forth in an inaugural address 'Ueber Gezeitenwellen,' by Krümmel, on his accession to the rectorate of the University of Kiel (Ann. der Hydrog., XXV., 1897, 337–346). Among

the special features mentioned are the following: The tide wave advances progressively from south to north on the west coast of Europe, but arrives simultaneously along a great stretch of eastern North America. It advances northward on the east coast and southward on the west coast of New Zealand, but arrives all at once on the eastern coast of Australia over a belt covering 26 degrees of latitude. Spring tide is delayed from half a day to two and a-half days after new moon at most Atlantic stations, but at Toulon, on the Mediterranean, it occurs $4\frac{3}{4}$ hours before the syzygies. The diurnal inequality, which should reach its maximum with the greatest declination of the moon, is belated on the European coast by from four to seven days, while at one point in the Gulf of Mexico it is accelerated by 17 hours. Much consideration is given to Boergen's discussion of interfering waves, whereby the notable differences between the tides of oceanic islands may perhaps be accounted for. The once-a-day tides on lunar time in the Gulf of Mexico and on solar time at Tahiti and elsewhere are thus to be explained. The studies of George Darwin and Lord Kelvin in the modifications suffered by the tide waves when running ashore have shown that 'overtides,' having shorter periods than normal tides, may be thus produced, and these are compared with the overtones of musical sounds, as explained by Helmholtz. The three tides in a day in the Tay at Stirling, Scotland, and in the harbors back of the Isle of Wight are thought to be of this nature. The continuous records of tide gauges reveal an increasing number of stations at which waves of short periods, from 5 to 90 minutes, are found, the shortest of these being much longer than the longest period of wind-made swell (12 to 15 seconds). Some of these oscillations, as in various arms of the Mediterranean, are probably to be compared with the seiches of lakes.

W. M. Davis.

CURRENT NOTES ON ANTHROPOLOGY.

31ST PEABODY MUSEUM REPORT.

The thirty-first report of the Peabody Museum of American Archæology and Ethnology describes the progress of its explorations and collections. Those in Central America were continued under the care of Mr. George Gordon. He examined various caves but did not find in them any objects of great antiquity. The collections of casts have been enlarged; but there remains much which the museum could do in this line if it had more funds. Mention is made of the liberality of the Duke of Loubat, of Miss Breton and others. Miss Whitney has given to the Museum the famous 'Calaveras skull,' together with the objects found around it. The general activity indicated by the Report continues to reflect the highest credit on the curator, Professor F. W. Putnam.

THE AIMS OF ETHNOLOGY.

A suggestive address was recently delivered before the Batavian Society of Arts and Sciences by Professor Bastian, who is making a prolonged journey in the Orient. His subject was 'The Purposes of Ethnology.' The style is simpler than is usual with this celebrated master, and his matter is highly suggestive. He emphasizes the principle that ethnology concerns itself only with man as a social being, and that he derives all his worth from the others with whom he lives. The elementary thoughts of savage tribes should occupy our first attention. From these we should trace the ethnic modifications which arise in the course of development. They stand in close relation to geographic conditions, which are always the leading factors in ethnic evolution. These thoughts are well brought out in Professor Bastian's address.

THE ARAUCANIAN TONGUE.

The twenty-first volume of the Library of American Linguistics, published in Paris,

is taken up with a comprehensive grammar and dictionary of the native language of Chili, called by some the Araucanian, but in this instance the Auca. The author is Mr. Raoul de la Grasserie. His treatise occupies 372 pages and embraces a large number of texts. To these he adds a literal translation and a grammatical analysis. His previous studies on American languages and on the philosophy of language in general guarantee his accuracy and thoroughness. He has used the moderately abundant writings of previous scholars with judgment, and throws new light on several points heretofore obscure in the construction of the tongue. (Langue Auca, Paris, 1898, J. Maisonneuve.)

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

AT a meeting of the Institution of Civil Engineers (Great Britain) held March 15th Mr. Henry Fowler read a paper on 'Calcium Carbid and Acetylene,' which summarized the present knowledge of the subject. From the full abstract in *Nature* we note the following: As the power theoretically required to produce one pound of calcium carbid in the electric furnace is more than 2 H.P. hours, its manufacture is at present restricted to localities where power is cheap, as, for instance, where water-power is available. The acetylene flame has a high actinic value, and causes light colors to appear lighter and dark colors darker than when exposed to sunlight. The gas, when inhaled, combines with the hemoglobin and renders the blood incapable of taking up oxygen; it is no more dangerous, however, in this respect than coal gas. With calcium carbid at $80 a ton, acetylene can compete with coal gas at 62 cents per thousand feet, where flat flames are used for the latter, and a light of not less than 30 candles is required. It is now used for lighting a station on the Great Southern and Western Railway of Ireland, and at the Salford Docks of the Manchester Ship Canal. Its price prevents its use for gas-engines. It cannot be used economically to enrich coal gas, as with low percentages the increase is not above 1 candle-power for 1 per cent. acetylene. With water gas it is even less applicable, as more than 10 per cent. is required before any illumination is obtained. Methane and nitrogen are claimed to carry the gas without affecting its illuminating power.

THE subject of the Watt Memorial lecture, delivered March 11th at Watt Memorial Hall, by Professor Thorpe, was 'James Watt and the Discovery of the Composition of Water.' The honor of this discovery, which is one of the landmarks of the history of chemistry, has been shared by Cavendish and Lavoisier, but Professor Thorpe shows that Watt, whose connection with the discovery has been generally regarded as incidental, in writing to Priestley, April 21, 1783: "Are we not, then, authorized to conclude that water is composed of dephlogisticated (oxygen) and inflammable (hydrogen) air or phlogiston deprived of part of their latent heat," was the first, as far as we can prove from documentary evidence, to state distinctly that water is not an element, but is composed, weight for weight, of two other substances, one of which he regarded as phlogiston and the other as dephlogisticated air. It was on June 25th following that Lavoisier announced his discovery to the Academie des Sciences, while Watt's letter to Priestley was published with another letter of his in in the *Philosophical Transactions* as having been read on April 29, 1784. In reality, however, Watt antedated Lavoisier more than two months.

THE rare element gallium has been found by Professor Hartley and Mr. Hugh Ramage to be very widely distributed in the earth

and also in meteoric bodies, as has already been noticed in these notes. It, therefore, appeared to be of interest to determine if it is present in the sun. A paper on this subject has been read by these authors before the Royal Dublin Society. The first problem was to determine with great accuracy the wave-lengths of the principal lines in the spectrum of gallium. This was accomplished by photographing the spectrum of gallium with the 21.5-feet radius grating spectrograph in the Physical Laboratory of the Royal University of Ireland. The wave-length of the two principal lines was found to be 4,172.215 and 4,033.125. In Rowland's map of the solar specrum 4,172.211 is given as an aluminum line and 4,033.112 as not identified. As gallium is present in every bauxite and shale and every specimen of aluminum examined by the authors there is no doubt that this line should really be attributed to gallium and not to be aluminum. Gallium must, therefore, be added to the list of elements known to occur in the sun; which only emphasizes the wide-spread occurence of this element in nature.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

CIVIL SERVICE EXAMINATIONS IN SCIENCE.

Two important scientific positions are to be filled under the Smithsonian Institution, by examination, on June 7th.

One of these is that of Assistant Curator, Division of Mammals, U. S. National Museum, with a salary of $1,500 per annum. Competitors will be rated in the elements of education, experience, publications and thesis, which will be weighted 10, 15, 50 and 25, respectively. Applicants will be furnished with the subject for the thesis, and with special forms upon which it is to be submitted. The Department states that it is desirable that persons certified for this position shall be men not less than 25 nor more than 40 years of age, and that they should possess a good general education (college graduates preferred); a general knowledge of zoology, and a thorough knowledge of mammalogy, more especially as relating to the North American fauna; they should have a practical knowledge of field-collecting, and of museum methods of preserving, arranging and labeling collections.

The second vacancy is in the position of Physicist, for special work in connection with the Astrophysical Observatory, Smithsonian Institution, at a salary of $1,000 to $1,200 per annum. This examination will consist of the subjects below, which will be weighted as follows:

General physics,	7
Physical laboratory training,	5
Treatment of observations,	2
Mechanical drawing,	2
French,	1
German,	1
English,	2
Total,	20

MUSEUMS OF THE SCIENCE AND ART DEPARTMENT, LONDON.

THE Select Committee appointed to inquire into and report upon the administration and cost of the Museums of the Science and Art Department have agreed to the following first report:

Since the issue of the report of the Museums of the Science and Art Department Committee in July, 1897, your committee have continued the inquiry, but reserve for a further report the publication of additional evidence with their final review and recommendations.

They feel, however, bound to report without delay certain conclusions at which they have arrived, on consideration of the evidence, as regards the South Kensington Museum and the Geological Museum in Jermyn-street.

They are unanimously of opinion that with a view to present efficient management, to economy of administration, to future development of the collections, and to their full use for the purpose of exhibition and of instruction, it is necessary:

1. That the whole area on the east side of Exhibition-road (except that occupied by the Royal College of Science, which cannot be sacrificed except at great cost) be exclusively devoted to the Art Museum and the Art Library,

with provision for the conduct of the business connected with Loans of Art Objects and the Art Schools. They are satisfied that the whole of this space is required for the Art Schools, the due exhibition of the Art Collection and the administration connected with such a museum.

2. That provision for the whole of the Science Collection, the Science Library, for Loans of Scientific Objects and for the Science Schools be made on the west side of the Exhibition-road.

They are convinced that this concentration of Art on one side of the road and of Science on the other is essential to good administration, to satisfactory results from the money expended, and efficiency both in the museum and in the schools. This arrangement would allow space for the future development both of the Art and of the Science branches.

They also unanimously recommend that the Geological Museum in Jermyn-street be no longer occupied for the same purposes as now, and that the collections there exhibited be removed to the west side of Exhibition-road and made part of the Science collections.

OBSERVATORIES ON THE AZORES.

As we have already stated, the Prince of Monaco, on April 29th, brought to the notice of the Royal Society the project which he suggested to the British Association in 1892, of establishing a meteorological station on the Azores. As reported in the London *Times*, he said its objects, as he conceived them, were the observation of certain atmospheric disturbances apparently formed in this region, and the correction of the path assigned to others that are announced from America at too great a distance of time and space for there to be any assurance that their strength and direction may not be considerably modified before they reach European coasts. He pointed out that at such an observatory the study of seismic phenomena could be advantageously carried on, because in certain circumstances earthquakes felt in Europe had previously affected the Azores. Moreover, in the study of terrestrial magnetism, being situated in mid-ocean, it could render useful service, for the increasing use of electricity for lighting and traction was making it more necessary that magnetic observations should be carried out in very remote places. Observations made on the Azores would benefit many countries directly, because they interested all branches of the nautical profession as well as the populations of the western coasts of Europe. Since the scheme was first mentioned, in 1892, an event which he had awaited with much impatience had, the Prince said, arrived to help it, and that was the establishment of telegraphic communication between the Azores and Europe. Soon after this was done the Portuguese government gave effect to his views by setting up on the Island of San Miguel, under the direction of Captain Chaves, a regular meteorological station, which, however, was most modestly equipped. Finally, last year Captain Chaves was commissioned to establish on the Island of Flores, the most westerly of the Azores, a second station whose observations would usefully supplement those of San Miguel. Unfortunately this was even poorer than the other, and was not yet reached by the telegraph cable. In order that science might the sooner profit by the advantages promised by this observatory, and in order to guard against interruption of its functions, he proposed to give it a constitution founded on the principle of an international guarantee to be secured by the pecuniary contributions of the countries concerned. He suggested that this arrangement might be carried out by the various countries bearing the expense of the particular class of observation in which each was interested. One, for instance, might support observations on magnetic phenomena, another on those of the winds, and so on. Portugal, accepting the principle of an international *régime*, had commissioned Captain Chaves to invite the maritime nations concerned to give their adhesion to the project and to associate themselves with the organization of this meteorological service. It might, therefore, be hoped that in the near future an understanding would be arrived at as to the development of the observatories on the Azores, and he asked the Royal Society to use its great influence in the domain of science for securing the accession of England to the ideas he was upholding.

GENERAL.

PROFESSOR GEORGE H. DARWIN, of Cambridge, England, was elected a foreign honorary member of the American Academy of Arts and Sciences at its meeting of May 11th, in place of the late Professor J. J. Sylvester.

PROFESSOR NICHOLAS SENN, of Chicago, has been appointed Assistant Surgeon-General of the army with the rank of Lieutenant-Colonel.

PROFESSORS METCHNIKOF and ROUX, of Paris, have been elected honorary members of the Imperial University of Kieff.

THE council of the Institution of Civil Engineers, London, have made the following awards for papers read and discussed before the institution during the past session: Watt medals and premiums to Messrs. H. L. Callendar and J. T. Nicolson, B.Sc.; a Telford medal and premium to Mr. A. H. Preece; George Stephenson medals and premiums to Messrs. Whately Eliot and W. O. E. Meade-King; a Crampton prize to Mr. E. W. Anderson; Telford premiums to Messrs. L. B. Atkinson, Henry Fowler and W. L. Strange.

THE meeting of the British Association for the Advancement of Science in 1899 will be held at Dover, September 13th–20th. The meeting of the French Association will be held at nearly the same time at Boulogne, so as to enable the two associations to interchange visits. The preliminary arrangements for these meetings have already been made, and Professor Michael Foster will be nominated President for the meeting of the British Association at Dover. The meeting of the British Association in 1901 will be held at Glasgow. An important exhibition will be open in that city at the same time. The place of meeting for the previous year is not yet fixed, but we understand that an invitation to hold it at Bradford, Yorkshire, will be presented to the Association at the Bristol meeting next September.

AT a recent meeting of the General Committee of the Philosophical Society, Washington, a special committee, consisting of the President of the Society, Mr. Frank H. Bigelow; the Chairman of the Committee on Communications, Mr. J. H. Gore, and a Past-President, Dr. William H. Dall, was appointed to consider new lines of work and activity appropriate to the usefulness of the Society in the future.

THE death is announced, in *Nature*, of Dr. Karl Ludwig Fridolin von Sandberger, who until recently was professor of mineralogy and geology in the University of Würzburg, and Director of the Mineralogisches Institut. Although known for his many important contributions to mineralogical science, to the study of ore deposits and to the microscopic structure of eruptive rocks, he was likewise distinguished for his researches on the fossil Mollusca of various formations in the Rhenish provinces and other parts of Germany. His published works date back to 1847. During the years 1850–56 he issued, in conjunction with his brother, Dr. Guido Sandberger, 'Die Versteinerungen des rheinischen Schichten-systems in Nassau,' a work remarkable for the beauty of its illustrations and the fidelity of its descriptions, and one which was honored by the award of the Wollaston Fund, which was given to the authors by the Council of the Geological Society in 1855. In 1863 Dr. Fridolin Sandberger published 'Die Conchylien des Mainzer Tertiärbeckens;' in 1870–75 he issued, in two volumes, 'Die Land-und Süsswasser-Conchylien der Vorwelt;' and in 1882–85, 'Untersuchungen über Erzgänge,' an authoritative work on the subject of mineral veins. In the course of his long labors he turned his attention to the Mollusca of many different formations, from those of Devonian age to those of Pliocene and Pleistocene deposits. In later years his work became more concentrated on mineralogical science. In 1875 he was elected a foreign member of the Geological Society of London. He was born in 1826, and died at Würzburg on April 11th.

WE regret to record the deaths of Dr. Hermann Kämmerer, professor of chemistry at the Industrial School at Nuremberg, on April 12th, at the age of fifty-eight years; of Dr. Samuel Gorden, President of the Royal Academy of Medicine of Ireland, and President of the Royal Zoological Society of Dublin; and of M. Demontzey, Correspondent of the Paris

Academy of Sciences (Section of Rural Economy).

AT the Royal Institution, London, on May 12th, Lord Rayleigh delivered the first of a course of three lectures on 'Heat,' and on May 21st Mr. J. Arthur Thomson will begin a course of two lectures on 'The Biology of Spring.' The Friday evening discourse on May 6th was by Mr. E. A. Minchin, whose subject was 'Living Crystals.'

PROFESSOR H. G. SEELEY, F. R. S., is again conducting the annual course of excursions of the London Geological Field Class, arranged to illustrate the physical geography and geology of hills, valleys and rivers in the basin of the Thames. The following meetings were arranged for the present month: May 7th, Greenwich Park and Charlton; May 14th, Aylesbury; May 21st, Highgate and Hampstead.

A MEETING of the New England Association of Chemistry Teachers was held in the United States Hotel, Boston, on May 14th. There was a short business session and a dinner. Professor Theodore William Richards, of Harvard University, spoke on 'The Aim of the Harvard Requirements in Chemistry.'

THE Horticultural College at Swanley is for the first time opening courses of instruction to non-resident students of both sexes. Courses of lectures will be given during the summer—on 'Soils,' by Professor Warington, of Oxford; the 'Psychology of Plants,' by Professor Henslow, of the Royal Horticultural Society; and on the 'Culture of Flowers and Vegetables,' by the Misses Dean. Classes will also be held in bee and poultry keeping.

THE Russian government has decided to introduce the metric system of weights and measures throughout the Empire, and by order of the Czar a decree to this effect has been submitted to him for signature.

THE steam yacht 'Windward,' loaned to Lieutenant Peary for his Arctic expedition by Mr. Harmsworth, has arrived in New York, fifty-two days after leaving London.

AN electrical exhibition of much interest is now in progress in the Madison Square Garden, New York. Many of the exhibits are chiefly of technical interest, and others are arranged to attract spectators. But the exhibit as a whole deserves the attention of the student of physical science.

WE incidentally noticed last week that a kinematograph of the eclipse of the sun taken by Rev. C. M. Bacon, at Buxar, had disappeared. The London papers announce 'a reward of fifty pounds for the arrest of the person or persons who on Wednesday last stole a kinematograph negative of the last total eclipse of the sun, between the Royal Albert Docks and Egyptian Hall, in Piccadilly.'

THE House of Representatives has passed a bill appointing three commissioners to propose necessary revision of the statutes relating to patents, trade and other marks, and trade and commercial names. The commissioners are to be named by the President, and are to report to Congress such proposed revisions as may appear necessary to make the laws conform to recent international agreements.

AMBASSADOR WHITE has forwarded to the State Department a copy of a note from the German Foreign Office in regard to restrictions placed on United States fruit imported into Germany, from which it appears that the Imperial Chancellor has, in accordance with the opinion of experts, divided plants into three groups, namely: 1. Those absolutely prohibited. 2. Those admitted unconditionally; and 3. Those admitted upon being found free from the San José scale, after examination.

AN extraordinary feat was performed by the engineers of the Great Northern Railway at Hatfield; and by the engineers of the Pennsylvania Railroad, later, a greater feat was performed in the replacement of bridges on those lines. In the one case the replacement of the structure was effected in fifty minutes; in the other instance it required but *two minutes and twenty-eight seconds.* An English technical journal, at the time, asserted that the first statement was 'creditable and credible,' but that the second was entirely beyond belief. The whole story of the second of the two wonderful performances is, however, told by Mr. Joseph Richards, of the A. S. C. E., in a paper

read before the Engineers' Club of Philadelphia, December 4, 1897, and now in type. The method adopted is described and the statement above confirmed. As the English editor says, after reading it and frankly admitting its truth: "It is the old story of Columbus's egg; the thing is very simple when you know how to do it, and American engineers deserve credit for knowing how."

MR. J. G. JACK is conducting a series of lectures and field meetings at the Arnold Arboretum, Jamaica Plains, during May and June, for the purpose of supplying popular instruction about the trees and shrubs which grow in New England. The lectures are held on Saturday mornings at ten o'clock and on Wednesday afternoons at three o'clock, beginning on Saturday, May 7th, and closing June 25th. The class assembles each day in the lecture-room of the Bussey Institution, where a review is given of certain groups of trees and shrubs. It then adjourns to the Arboretum for an informal out-door study of the plants.

THE bill before the Massachusetts Legislature for the promotion of anatomical science, a measure amending the present law relative to the disposal of bodies for dissection, so that the four leading colleges of the State shall have the bodies of paupers from State institutions, unless the pauper requests an ordinary burial, during his last illness, or the same request is made by one of his friends, has been ordered for a third reading by a vote of eighty-three to forty.

THE Governor of Hong Kong has reported to the Secretary of State for the Colonies that there have been 609 cases of plague in that colony during the current year. The return is complete up to April 25th, and in the last week which it embraces there were 127 cases, or over one-fifth of the total for the four months. Cultures of bacilli from suspicious cases of illness in Calcutta have been sent to Bombay to be subjected to Professor Haffkine's examination and have been pronounced to be those of true bubonic plague.

IT is stated in *Nature* that the Liverpool Marine Biology Committee's Easter party, at the Port Erin Biological Station, included Mr. Isaac C. Thompson, Mr. Frank J. Cole, Mr. R. A. Dawson, Mr. H. C. Chadwick, Professor Herdman, and several students from University College, Liverpool. The Lancashire Sea Fisheries steamer is also at Port Erin, and several dredging and trawling expeditions are taking place. Spawn of several fishes has been obtained and fertilized, and is now developing in the tanks. Under the care of Mr. Chadwick, Curator of the Station, the aquarium is in a flourishing condition, and contains a number of interesting animals, some of which are spawning. A recent addition to the laboratory accommodation at the Station has been completed, which gives five additional work windows for students, so that there is now plenty of room for other workers.

THE will of the late Mr. Oliver A. Judson, of Philadelphia, has bequeathed to the College of Physicians of that city $1,000, the interest, whenever it amounts to $100, to be offered as a prize for the best original essay on 'The Practical Prevention of Disease.' The essay must be written in English, but the competition is open to foreigners.

MR. BERNARD QUARITCH, London, offers for sale a complete set of the transactions of the Zoological Society, London, beginning in 1833, for £52 10s. The set is very rare and being sold much below the cost of publication would be a valuable addition to many American libraries. A copy of the first edition of Izaak Walton's *Compleat Angler* was sold recently in New York for $240.

THE arrangements for laying the cable from Iceland by way of the Faröe Islands have been completed, and the cable will be laid during the summer.

UNIVERSITY AND EDUCATIONAL NEWS.

OWING to demonstrations upon the part of the students, the Universities of Naples, Bologna and Rome have been closed.

THE next meeting of the Association of Colleges and Preparatory Schools of the Middle States and Maryland will be held at Columbia University, New York City, N. Y., on Friday and Saturday November 25 and 26, 1898.

PLANS have been completed for a new build-

ing for the Jefferson Medical College, of Philadelphia, which will be erected at the corner of Walnut and 10th streets, occupying a space of 118 feet by 107 feet. It appears, from the plans, that very complete arrangements have been made for laboratories, lecture rooms and dissecting rooms.

A DONOR, whose name is withheld, has subscribed \$25,000 for Barnard College in case the \$100,000 needed to liquidate the debt on the College is subscribed by October 3d. \$23,000 had previously been subscribed.

PROFESSOR JAMES SETH, who now holds the chair of moral philosophy at Cornell University, has been elected professor of moral philosophy in the University of Edinburgh, to fill the chair vacant by the death of Professor Calderwood.

DR. CHARLES H. JUDD, Wesleyan University, has been called to a chair of psychology in New York University.

DISCUSSION AND CORRESPONDENCE.

REMARKS ON THE METHOD OF THE 'NEW PSYCHOLOGY' WITH MEMORY.

TO THE EDITOR OF SCIENCE: Dr. Scripture's 'The New Psychology' is an interesting and useful résumé of the results of a certain order of investigation whose value and significance seems at present, however, debatable. The author wishes, and wishes rightly, to reduce psychology to an exact science, but does not science mean a complete and special investigation of the circumstances affecting any phenomenon? Take thus the phenomenon of memory: Does not a scientific study of it require a thorough and special investigation of all factors psychical that affect it, to show their interrelation, and by isolation to show their relative values? Is not this method required of the biologist who studies the phenomenon of cross-fertilization or of the physicist who studies crystallization, and shall we be less rigid for the psychologist who studies memory? Now Mr. Scripture starts out with the assumption that a memory is a function of one element, physical time, and interprets wholly by this factor, lumping all other elements under a mere general reference to 'circumstances' and the 'individual.' It is not to be denied that physical time by pendulum beats has some relation to memory, but Mr. Scripture certainly fails to make clear that he has isolated this phenomenon, which is, moreover, of minor importance. Memory is far more a function of interest than of time, either physical or psychological. For instance, in the experiment detailed (p. 189) the matter of seconds and minutes is not the main determinant of decreasing memory with the experimenter. On the contrary, interest, his interest in accuracy, in success, etc., is the main factor to be investigated, and to study memory without definitely studying interest is like testing speed of locomotives without reference to motive power. That a locomotive moves at certain reduced velocities after certain lapses of time does not imply that time *per se* has reduced velocity in given ratio, but that this ratio is dependent on the initial head of steam, lubricity of parts, etc. Now the motive power of memory is interest, and mere lapse of time operates mainly, at least, merely as allowing room for conflicting interest. It is plain that if in the experiment referred to the agent was influenced by life and death motive, or even by some greatly desired prize, the memory power would be indefinitely strengthened. What very intensely interests us we always remember, and often with increasing vividness, for memories becoming cumulative in effect may reinforce each other so as to more than offset lapse of time. We also note that the aged man recalls the scenes of youth much more acurately and freshly than when he was middle aged. We know also that interest quite reverses the time law in the case of one who after some years absence returns to his former dwelling place, when events and places concerned with his life some time before his absence are recalled with accuracy far greater than if he had had continued residence.

It is certainly very desirable that we should attain to some scientific understanding of the relation of interest to memory, but first we must devise some method of measuring interest. But any real science of memory cannot neglect that by which memory has been originated and developed, namely, interest.

But the whole standpoint of 'the New Psy-

chology' is unpsychological. Psychology is not primarily concerned with the time of sense, but with the sense of time, that is, it is not primarily concerned with the physical or physiological. Hence to make memory merely some simple function of time, as logarithmic, just as we find gravity to vary inversely as the square of the distance, is an enticing but false simplification of psychic act. While the physics of psychology is an interesting if somewhat limited field, it does not deserve the term 'the New Psychology.' 'The New Psychology' is that which has felt the stimulus of evolutionism, and whose standpoint is not physical but biological. The psychic phenomenon is a life method, and thus memory is a function of and for life, a mode of building up experience into a whole which should serve the individual and race as a sort of psychic capital.

Now the failure to take biology as the main standpoint leads to the very unsatisfactory remark (p. 208) that similarity, contrast, etc., are not real laws of association in memory, but only 'schemes for classifying associations,' and that the 'real law' has never been found. That is, we understand that some psycho-physical law yet undiscovered is the real scientific explanation, and the present psychology of memory by laws of similarity, contrast, etc., has little or no value. But appreciation of likeness and sameness, for instance, is of the greatest importance to the living organism, as in recognition of food, mate, etc., and hence it has become a prime method or law of mental organization. Mind in animals and men is not a general exhibition of elemental energy in space and time, but a practical device for the advantage of the individual and posterity; hence the laws of association, as commonly given, are vital laws and real laws of connectivity in mind reaching to adaptation.

We conclude that to come to the study of mind by the way of physics is to come by a back door. While we should certainly try to enter by every door that can be found back, side or front, yet the best, most comprehensive and reasonable view comes by way of the front entrance through biology.

HIRAM M. STANLEY.

LAKE FOREST, ILL., April 25, 1898.

THE CAUSES OF NATURAL ARCHES.

TO THE EDITOR OF SCIENCE: The note in your April 22d number regarding the natural bridge in Utah is interesting, but I should like to supplement it by stating another interesting thing, namely, that there are in the great arid region a large number of these natural arches. In the Canyon of Desolation, on Green River, they are particularly common, and from the surface of the river some of them seemed of huge proportions. All I have seen occur in formations exactly similar in kind—homogeneous sandstones with tendencies toward conchoidal fracture—and my observations are against the wind erosion theory as a prime factor.

The beginning appears generally to be in some natural crevice or cleft on the face of the bare cliff wall, where water is able to penetrate and allow frost to start operations by throwing out a fragment that leaves a cavity almost a miniature of the final perforation which marks one further period in the demolition of the cliff. This fragment is followed by many others, till the cavity presents the appearance of an alcove with arched top, and a talus floor. The arch gradually deepens into the cliff, and I have seen one so deep that its floor was a lake, with a grove of trees at the opening. Frequently, if not generally, the deepening is assisted by water percolating from above.

At a certain depth, if the cliff is a thick one, the arch begins to protect itself, and the excavation proceeds more slowly. It becomes a cave with floors of various character according to circumstances that vary with other conditions. But if the cliff is comparatively thin the wearing finally cuts through to the opposite side, and then wind erosion becomes a more potent factor. I have seen many examples of every stage of progress, and I have seen at least one beginning where a rain torrent was in active operation, and made a sketch of it. Frost, and the disintegrating and dissolving power of water combined with structural tendencies, appear therefore to be the chief causes of these natural arch forms.

F. S. DELLENBAUGH.

NEW YORK, May 3d.

SCIENTIFIC LITERATURE.

Anatomische Litteratür in Amerika. I. Wilder's System der Nomenclatur. Von THOMAS DWIGHT in Boston. Separatabdruck aus Ergebnisse der Anatomie und Entwickelungsgeschichte. Wiesbaden. 1897.

It is now some twenty-six years since Dr. Wilder commenced his crusade against current anatomical nomenclature, and during that time his activity has been great. Firmly imbued with the idea that reform is urgently required, he has been prolific in inventing new terms and urgent in pressing their acceptance upon the scientific public. Although his following has not been numerous, most scholars being repelled by his fantastic terms and his defects of literary form, yet by persistence and iteration he has made himself a veritable force in the anatomical literature of this country, a force that must be reckoned with whenever any question of terminology is to be considered.

The paper here presented to the German reading public by the well known professor of anatomy in Harvard University is an attempt to correct certain misapprehensions that have arisen in Germany with regard to the views of Dr. Wilder and the position he occupies. In order to explain how these misapprehensions arose it will be necessary to touch briefly upon certain matters that, while familiar to those interested in nomenclature, are not widely known to the public at large.

When, in 1889, the Anatomische Gesellschaft, the principal foreign society of anatomists, appointed a committee to consider the subject of nomenclature it was natural that Dr. Wilder should be consulted. Several American scientific societies had appointed similar committees,* and in these Dr. Wilder took great interest, obtaining from them, either directly or indirectly, some brief and very moderate reports not antagonistic to his views. These he forwarded in considerable numbers to the German committee, together with some publications of his own. It seems that he did not at all realize the ignorance that naturally prevails in Germany as to scientific work in this country, and that, although he had no official standing whatever that would authorize him to speak for American anatomists, he created the impression that he represented some American committee that indorsed and supported all his somewhat revolutionary ideas.

Under this misapprehension the Anatomische Gesellschaft made the following formal protest against what they assumed was the American scheme:

"The Anatomische Gesellschaft thinks it ought to take a stand against the attempts of the American Committee on Nomenclature. It recognizes the usefulness of as short names as possible and the aptness of some suggestions which have came from America. It protests, however, against the inconsiderate use of mononyms and the consequent radical remodeling of anatomical language as it has existed hitherto. To follow the American committee in this course is forbidden to the Anatomische Gesellschaft by the acknowledged laws of general language formation as well as by a regard for the historical development of our own science. Should the construction of a peculiar anatomical terminology make progress in America along these lines, an impassable chasm would be formed between those who pursue anatomical studies and those who devote themselves to medicine, and thus coöperation in scientific work would be deeply disturbed."*

Again, when the list of terms adopted by the Gesellschaft came to be published, it was accompanied by some rather tart remarks by Professor His concerning the 'American committee and its very zealous member, Mr. Wilder,' who had 'already published a lot of small papers and pamphlets.'

In consequence of his strictures there ensued a rather acrimonious correspondence between Dr. Wilder and Professor His, in which both parties appear to have lost their tempers, and from which no distinct advantage accrued to science.†

Dr. Dwight proceeds to give an accurate account of the American committees, their recommendations and the official connection of Dr. Wilder with them, showing that they were in no way responsible for his acts and had never recommended the comprehensive remodeling of anatomical terminology that he advocates.

* The American Association for the Advancement of Science, the American Neurological Society, and the Association of American Anatomists.

* *Anatomischer Anzeiger*, Ergänzungsheft zum Xte Band, 1895, p. 162.

†Published by Wilder in his Neural Terms, *Jour. of Comp. Neurology*, 1896.

Some of the peculiarities of the Wilder system are then briefly discussed, attention being called to its disregard of the ordinary principles of language formation as exemplified by: 1st. The mutilation of words, as by using 'alinjection,' for injection with alcohol; chippocamp, for hippocampus major, etc. 2d. The substitution of monomial terms ('mononyms,' Wilder) for those sanctioned by long usage and historic precedent. In recent publications we are asked, for example, to say 'restis,' for restiform body; 'praecribrum,' for anterior perforated space; and 'quadrigeminum,' for corpora quadrigemina. In this matter the majority of anatomists will probably agree with Professor His that "the contraction of several words into one may under certain circumstances be an improvement, but as the conciseness of a telegram may lead to its obscurity, so terms used in this way may, from their very brevity, demand a special explanation for their comprehension."* Dr. Dwight cites, with approval, the writer in *Nature* who styles this system a scientific Volapük. Dr. Wilder himself recognizes the necessity for furnishing a vocabulary for his peculiar tongue, as is done with the artificial language just cited, for his longer essays are accompanied by a chapter of definitions, and his shorter ones have numerous parenthetic interpolations for explaining the meaning of his terms.

The degrading influence that such inartistic curtailments must have upon ordinary literary style is pointed out by Dr. Dwight. We notice in a recent publication from Dr. Wilder's pen that 'anatomic teachers' are mentioned, by which grisly term he apparently means teachers of anatomy.

Dr. Dwight suggests that some of the oddities of this system have, doubtless, arisen because of the peculiar isolation of Dr. Wilder from those who are using human anatomy practically and who, therefore, feel the necessity of preserving unbroken the traditions of anatomical speech. Medicine and surgery have never been taught at Cornell University, and Professor Wilder's chair is not that of human anatomy.

The general verdict of foreign anatomists is strongly against these innovations, and is well voiced by the following temperate and wise rebuke administered by the veteran Kölliker, who was Chairman of the Committee on Nomenclature of the Anatomische Gesellschaft:

"I regard the anatomical nomenclature that has emanated from America in recent years as a complete failure, and so inappropriate that it is impossible for me to read articles based thereon. One can hardly ask a scholar who has received a regular training to accept quietly the many barbarisms of this nomenclature, such as *metatela*, *metaplexus*, *auliplexus*, *diaplexus*, *ectocinerea*, *cephalad*, *caudad*, *dorsad*, *cephalo-dorsad*, *ventro-caudad*, *dorso-caudad*, *hemi-cerebrum*, etc., and to turn back and find out the meaning of a great number of other terms, such as *terma*, *proton*, *pero*, *prosoterma*, *diaterma*, *supraplexus*, *aula*, *alba*, *crista*, *diacoele*, *mesocoele*, etc. As the oldest German anatomist, I may, perhaps, be permitted to advise my American colleagues not to proceed farther upon this path lest it might happen that, in the course of a few years, the anatomists on this and on that side of the water no longer understand each other and all scientific interchange of ideas become impossible."*

Dr. Dwight protests against the designation 'American' as applied to the Wilder system, and closes his too brief article as follows:

"As regards the future it may be that an unexpected prophecy may be deduced from its likeness to Volapük. That pseudo-speech has fallen, apparently never to rise again. Whether the Wilder system as a whole will outlive the loss of the great influence and enthusiasm of its author, which must naturally occur in the course of human events, is very doubtful; it is certain, however, that whatever good there is in it will survive beyond that day which we hope may still be far distant."

FRANK BAKER.

A Description of Minerals of Commercial Value. By D. M. BARRINGER. New York, Wiley & Sons. 1897. First edition. Pp. 168.

Barringer's 'Minerals of Commercial Value' is a small volume bound in flexible cloth issued

* Die Anatomische Nomenclatur, p. 7.

* Kölliker, A. 'Handbuch der Gewebelehre des Menschen.' 6te Aufl. Band II., p. 814.

for the use of miners, prospectors and business men. From its preface we learn that "the work is intended merely as a book of reference to be used by the practising miner or man of business, for whom especially it is intended, as well as by the geologist, metallurgist or mineralogist in so far as it may serve their purposes. * * * The original intention of the author was to give, in as simple and concise a form as possible, a description of the nature of only the more important of those mineral substances, more frequently referred to as ores or compounds, *which possess commercial value*, indicating at the same time means by which they could be identified, and referring very briefly to some of the principal economic uses to which they are put. Upon reflection, however, it seemed advisable* *to insert also a description of a few other minerals which are very frequently met with as common veinstones or as rock constituents, although they may possess in themselves no commercial value." In short, the book is a work on determinative mineralogy in which, however, only the most important compounds are discussed. There is nothing noteworthy in the treatment of its subject-matter, unless it be the arrangement of the minerals according to their metallic constituent. Whether this manner of arrangement is as good as one based on hardness, density or some other physical property is at least doubtful. Indeed, it is probable the book throughout is too technical for miners, prospectors and business men, though it may easily be of assistance to metallurgists and geologists, more because of its convenient form than because of anything of especial value in its contents.

The first part of the volume contains a list of atomic weights, statements of the characteristics of the crystal systems, the scale of hardness and brief descriptions of the most important blow-pipe reactions and wet tests for the different chemical elements.

The second part is made up exclusively of tables. The minerals of each metal are listed alphabetically and opposite each is given its chemical composition, a statement of its general character and its occurrence, a description of its behavior toward reagents, its color, lustre, etc., and, finally, an account of its uses. In three appendices following the lists of minerals is a condensed form of Brush's classification of minerals according to lustre and fusibility, a list of simple tests for the most important chemical elements and a brief description of the simpler processes of assaying.

The book is carefully compiled and is well printed. It is accurate and therefore trustworthy. Although, as has already been stated, it contains no novel features, it will serve as a convenient companion, because of its handy size, to any one capable of using it. It is the most compact determinative mineralogy in the market.

W. S. BAYLEY.

COLBY UNIVERSITY.

SCIENTIFIC JOURNALS.

The Journal of Geology for February–March, 1898 (Vol. VI., No. 2), contains the following papers: 'Brazilian Evidences on the Genesis of the Diamond,' by Orville A. Derby. The author endeavors to draw a parallel between the geology of the South African Diamonds and of those of Brazil. Three Brazilian localities in Minas Geraes are selected, viz., San Joâo da Chapada, Grâo Mogol and Agua Suja. At the first it is uncertain whether the diamonds are derived from phyllites or from contact zones in the phyllites next intrusions of pegmatites, or from the pegmatites. In the second locality they seem to be allothigenic minerals in metamorphosed clastics. At the third place there are basic intruded rocks, more or less analogous to those at Kimberley, but it is still an open question whether the diamonds have been derived from them or from the neighboring schists. Excessive weathering and the present abandoned condition of the Brazilian mines mask the evidence. 'The Glaciation of North Central Canada,' J. P. Tyrrell. The author describes the three successive glaciers of this portion of Canada, viz: 1st, the Cordilleran, that spread from the Cordilleras eastward and then retreated; 2d, the Keewatin, that originated northwest of Hudson Bay and spread north, west, south, and to some degree east, and withdrew; 3d, the Labradorean, that began in central Labrador, spread in all directions, but especially southward; and on the northwest lapped

the Keewatin territory. The relations are illustrated by maps. 'The Use of Local Names in Geology,' C. R. Keyes. The paper is in the main a justification of the recent introduction and spread of local formational names. 'The Weathered Zone (Sangamon) between the Iowan Loess and Illinoian Till Sheet,' Frank Leverett. After an introduction describing the general relationships of the subdivisions of the glacial deposits concerned, the character, distribution and interpretation of the zone of weathered materials, called the Sangamon, are taken up. 'Studies in the Driftless Region of Wisconsin, II,' G. H. Squire. Several small areas are described in detail with sketches, and their topographical forms and superficial deposits are interpreted. 'Fucoids or Coprolites,' J. A. Udden. Fossils closely resembling the *Spirophyton*, of New York, are found in the Middle Devonian along the Mississippi River in Illinois and Iowa. Instead of fucoids, they are interpreted as coprolites from some mud-eating animals, such as sea-cucumbers. 'Zirkelite a Question of Priority,' M. E. Wadsworth. The author introduces, as in other current journals, his claims to priority in the use of the name zirkelite. Significant comments are added by one of the editors of the *Journal of Geology*. Editorials and reviews close the number.

The March number of the *Bulletin* of the American Mathematical Society contains the following papers: 'The Relations of Analysis and Mathematical Physics,' by Professor H. Poincaré, translated by Mr. C. J. Keyser; 'The Roots of Polynomials which Satisfy Certain Linear Differential Equations of the Second Order,' by Professor Maxime Bôcher; 'Inflexional Lines, Triplets and Triangles Associated with the Plane Cubic Curve,' by Professor Henry S. White; 'On the Intersections of Plane Curves,' by Professor Charlotte Angas Scott; 'Euler's Use of i to Represent an Imaginary,' by Professor W. W. Beman; 'Note on the Roots of Bessel's Functions,' by Dr. M. B. Porter; 'Shorter Notices;' 'Notes;' and 'New Publications.'

The April *Bulletin* contains an account of the February Meeting of the Society, by the Secretary; 'The Theorems of Oscillation of Sturm and Klein (First Paper),' by Professor Maxime Bôcher; 'Some Examples of Differential Invariants,' by Mr. Charles L. Bouton; 'On an Extension of Sylow's Theorem,' by Dr. G. A. Miller; 'Note on the Tetrahedroid,' by Dr. J. I. Hutchinson; 'Note on Integrating Factors,' by Mr. Paul Saurel; 'Early History of Galois' Theory of Equations,' by Professor James Pierpont; 'Love's Theoretical Mechanics,' by Mr. W. H. Macaulay; 'Schell's Tortuous Curves,' by Professor Alexander Ziwet; 'Page's Differential Equations,' by Professor Edgar Odell Lovett; 'Shorter Notices;' 'Notes;' and 'New Publications.'

SOCIETIES AND ACADEMIES.

AMERICAN MATHEMATICAL SOCIETY.

A regular meeting of the American Mathematical Society was held at Columbia University, New York City, on Saturday, April 30th. As has now become the rule, the meeting extended through a morning and an afternoon session. In the interval a pleasant opportunity is offered to those present to lunch together in the restaurant on the grounds of the University. Thirty persons were in attendance, and thirteen papers were read, both numbers much exceeding the record of the same season in previous years. At the meeting of the Council seven persons were elected to membership in the Society, and four applications for membership were received. The By-Laws of the Society were amended to provide for life membership, the dues being fixed at $50, exclusive of initiation fee.

The following is a list of the papers presented:

Morning Session.

1. Professor W. F. Osgood: 'Example of a single-valued function with natural boundary, whose inverse is also single-valued.'

2. Mr. J. K. Whittemore: 'A proof of the theorem:

$$\frac{\partial^2 f(x, y)}{\partial x \partial y} = \frac{\partial^2 f(x, y)}{\partial y \partial x}.'$$

3. Mr. H. E. Hawkes: 'The limitations of Greek arithmetic.'

4. Professor H. S. White: 'The construc-

tion of special regular reticulations on a closed surface.'

5. PROFESSOR E. O. LOVETT: 'Infinitesimal transformations of concentric conics.'

6. PROFESSOR E. O. LOVETT: 'Note on infinitesimal projective transformations.'

7. PROFESSOR MAXIME BÔCHER: 'Note on Poisson's integral.'

AFTERNOON SESSION.

8. MR. W. M. STRONG: 'On the necessity of continuity in Euclid's geometry.'

9. PROFESSOR A. G. WEBSTER: 'Note on Stokes' theorem in curvilinear coordinates.'

10. PROFESSOR E. B. VAN VLECK: 'On the polynomial of Stieltjes.'

11. MR. G. P. STARKWEATHER: 'A solution of the biquadratic by binomial resolvents.'

12. DR. G. A. MILLER: 'On the supposed five-fold transitive function of 24 elements and $19! \div 48$ values.'

13. DR. G. A. MILLER: 'On the Hamilton groups.'

The Summer Meeting of the Society will be held at the Institute of Technology, Boston, Mass., on Friday and Saturday, August 19th and 20th, in affiliation with the American Association for the Advancement of Science. A colloquium will be held in connection with the meeting, two courses of lectures being offered by Professor W. F. Osgood, of Harvard University, and Professor A. G. Webster, of Clark University.

F. N. COLE,
Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 484th meeting of the Philosophical Society was held at the Cosmos Club, at 8. p. m., April 30th. The first paper was by Mr. William Eimbeck on 'Terrestrial Refraction,' as related to the determination of heights by trigonometric processes.

Conceiving refraction to depend solely upon the density of the atmosphere, he showed that it varies not only with the hour of the day, but likewise with the seasons of the year and the heights above the sea, etc. Also, that the diminution of the refraction with heights as exhibited by the coefficients for the various levels of elevation must not be neglected, as is customary in the computation of heights from zenith measures, if the utmost attainable precision is sought. On account of the decrease of atmospheric density, the refraction at a higher station is necessarily always less than at a lower station.

This is a condition, the effect of which is not eliminated by simultaneous measures of reciprocal zenith distances.

The second paper was by E. D. Preston on 'Recent Progress in Geodesy.' After a brief historical review of what has been done thus far in determining the size and shape of the earth, attention was called to some recent measurements of parallel arcs. It was pointed out that both in Europe and America the above measures indicate a smaller radius of curvature than that determined by Clarke's mean figure. The work of the International Geodetic Association was then taken up and a summary given of its recent investigations in the variations of latitude. The fact was noted that it is proposed in the near future to establish four international stations, two of which will be in the United States, and all of which will be within half a mile of the parallel 39° 8′. The most favorable conditions for successful work at these stations were described as well as the mathematical and physical reasons bearing on the choice of location.

E. D. PRESTON,
Secretary.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

BY invitation of Dr. C. F. Chandler and the authorities of Columbia University the regular meeting of the Society was held Friday evening, May 6th, at Havemeyer Hall, after a dinner in the University restaurant, at which forty-two members were present. Dr. Chandler made an address of welcome and gave a sketch of the inception and development of the Columbia School of Mines and its successor, the present 'Faculty of Applied Science.' The Chairman then made some remarks expressing appreciation of the invitation from the University, and of the interest in the Section manifested by supplying the entire program of papers, the reading of which was proceeded with as fol-

lows: 1. J. A. Mathews, 'The Action of Nitrils upon Aromatic Acids.' 2. E. H. Hodgson, 'The Determination of Sulphur in Asphalts.' 3. S. A. Tucker, 'A Few Remarks on the Persulphates.' 4. W. D. Engle, 'The Action of Metallic Thio-Cynates upon Organic Chlorhydrins.' 5. A. G. Betts, 'Alcoholic Ethers of Nitro, Amido and Oxy Benzyl Alcohol.'

Mr. Hodgson had determined the sulphur in a variety of asphalts by several well-known methods, one of which was modified by the use of sodium peroxide. He found the following amounts of sulphur and differences by the several methods:

	Nitric acid. (Carius).	Sodium. Peroxide.	Deflagration.
Trinidad Lake	4.33	3.77	3.80
" crude	4.10	3.33	3.2
" refined	4.46	4.07	3.6
Cuban crude	3.61	3.10	2.8
Alcatraz crude	5.45	3.98	4.2
California crude	7.51	6.26	6.5

In order to have time to inspect the laboratories it was moved and seconded that the last three papers should be postponed to the next meeting, and after passing a vote of thanks to Dr. Chandler and the authorities of the University a tour of the chemical department laboratories was made.

DURAND WOODMAN,
Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, MAY 10.

PROFESSOR H. A. PILSBRY spoke of certain embryonic or nepionic characters of Bulimulidæ having a bearing on the classification of the group. In the case of some of the young shells a fine grating on the upper whorls comes to a stop where the shell is hatched; in others there is no sculpturing, while in others there are zigzag or equidistant ridges with fine striæ between. These characters can be correlated with peculiarities of the soft anatomy, but not with those of the adult shell. The geographical distribution of the groups thus defined was given, and illustrative specimens of embryonal apices were shown under the microscope.

Professor Pilsbry also made a communication on the results of recent work on the mollusca of Lake Tanganyika and demonstrated the relationship of the halolimic genera to marine forms.

Mr. Joseph Willcox exhibited a fine series of *Cypræa exanthema* and *C. cervus* to sustain his opinion that these species grade into each other and that *cervus* can scarcely be considered even a variety of the other. He believed the mantle filaments of *Cypræa* have a direct influence on the formation of spots on the shell, perhaps secreting the light color to which they were due.

Professor E. G. Conklin read a paper on the environmental and sexual dimorphism of *Crepidula*. The conclusion was reached that it is a case of protandric hermaphroditism and of marked sexual dimorphism. The communication was presented for publication and will appear in the *Proceedings* with illustrations.

Papers on certain aboriginal mounds of the South Carolina coast, the Savannah River, and the Altamaha River, by Clarence B. Moore were also presented for publication and will form part of the next number of the *Journal*.

EDWARD J. NOLAN,
Recording Secretary.

NEW BOOKS.

Outlines of the Earth's History. N. S. SHALER. New York, D. Appleton & Co. 1898. Pp. iv+417. $1.75

Brown Men and Women. EDWARD REEVES. London, Swan, Sonnenschein & Co.; New York, The Macmillan Company. 1898. Pp. vi+294. $3.50.

The Story of Photography. ALFRED T. STORY. New York, D. Appleton & Co. 1898. Pp. 169.

Electro-Physiology. W. BIEDERMANN; translated by FRANCES A. WELBY. London and New York, The Macmillan Company. 1898. Vol. II. Pp. vii+500. $5.50.

Organic Chemistry. JOHN WADE. London, Swan, Sonnenschein & Co.; New York, The Macmillan Company. 1898. Pp. xvi+460. $1.75.

SCIENCE

FRIDAY, MAY 27, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*ON THE GENETIC ENERGY OF ORGANISMS.**

FOR several years the conviction has been growing more and more definite in my mind that the fundamental principle in vital phenomena is to be found in variation rather than in heredity. The first time this opinion was definitely expressed in print was in 'Geological Biology' (1894): "Variability is thus assumed to be an inherent characteristic of all organisms, and origin of species has primarily to consider how comparative permanency of characters, and of different sets of characters in different lines of descent, is brought about" (p. 184); and: "The search has been for some cause of variation; it is more probable that mutability is the normal law of organic action, and that permanency is the acquired law," etc. (p. 297). Two years later Professor L. H. Bailey said in his 'The Survival of the Unlike' (1896): "In other words, I look upon heredity as an acquired character, the same as form or color or sensation is, and not as an original endowment of matter" (p. 23). Perhaps others have published the same conclusion, but, if so, I have not elsewhere seen the point advanced as a scientific proposition.

The conviction was reached on my part through studies in paleontology. As early as 1881 I was struck by the evidence of a

*A paper read before the American Society of Naturalists, December 24, 1897, by Henry Shaler Williams, Yale College, New Haven, Conn.

beginning, adolescence, maturing and old age of races of species in the geological past, advanced by Hyatt and later elaborated so fully by him and others. I reflected back to the nature of development, which such geological recapitulation seems to imitate, as a process in which the cellular parts of the individuals are undergoing a constant process of varying, and I conceived of the law of recapitulation as an extension of the principle of varying first seen in the cells of the individual to successive organisms. This principle of 'recapitulation,' which was taught by Agassiz, emphasizes at least the wide applicability of variability in organic processes.

I have been testing, in all conceivable ways, the application of this theory to the facts of biology for the past fifteen years, but for only a short time have I been aware of the revolutionary nature of the conception.

As I discover no escape from the essential validity of the proposition, and because of the importance of it for future investigations, and because few biologists with whom I have spoken seem to understand the importance of the problem at issue, it may not be inappropriate to attempt at this time to state the foundation upon which the theory appears to rest.

THE SOURCE OF OUR KNOWLEDGE OF ORGANIC PHENOMENA.

One of the difficulties standing in the way of forming clear and distinct notions of organic phenomena lies in the fact that we are not accustomed to orient them in their exact relationship to the current notions of physical and mathematical science.

When we contemplate a physical body of matter as growing, varying, inheriting, acquiring characters or selecting, the body which performs these acts so far transcends anything which the physicist knows about simple masses of matter, and the performances so far transcend the kind of work he is accustomed to deal with, that, as a physicist (whatever his opinion may be of biologists), he frankly confesses he has no knowledge in the case. Without attempting any metaphysical discussion, and without stating whether the biologist does or does not know any more than the physicist in the matter, we may join hands with the latter in the belief that if anything is known about them it can be expressed in scientific terms only by an analysis of the observed phenomena in the case.

In seeking, therefore, for the fundamental characteristic of a living organism we ask, first, how does it differ, phenomenally, from a similar body not organic?

If we consider ultimate chemical or physical constitution we discover no fundamental distinction between a living organism and the same body of dead matter.

The same chemical elements compose them; the same physical properties pertain to each. Even mechanically, it is perhaps impossible to define wherein they differ.

When we observe the functions of the organism we note certain phenomena in the living body not operating in the same body after death; but in all these functions we discover none which are not like those of dead bodies of matter in this respect that a specific amount of equivalent of heat-energy is used in their operations, and the energy used is transformed from some other condition, as in inert matter, and no energy seems to be gained or lost in the process. Thus in the two aspects of constitution and action of the bodies it is difficult, and probably it is impossible, scientifically, to describe any constant point of difference in quality between an organism and a body of matter which is not alive.

There is, however, one point of difference: A living body is constantly changing in its material constitution, while an inert body remains the same. An organism persists in becoming different so long as it lives,

while a mass of matter remains in a state of rest or of uniform direction of motion, except as compelled by some outward force to change that state.

It may be objected, here, that this difference is a subjective one, and has no objective reality, in that a body, of which the substance is undergoing change, cannot be regarded as strictly the same body after as before the change.

If the objection be valid we must still remember that it is such a changing physical body which grows, inherits, acquires characters, etc., that we are studying.

But whether the objection be valid or not, it is essential to keep our attention on the objective reality, the living organism, whatever difficulties we may have subjectively; and the one group of phenomena which the live organism exhibits characteristically is that of becoming different.

It is, then, this distinguishing characteristic of the living body—its becoming different—that constitutes the point of view from which it is believed the true relations of the organism to other physical bodies may be seen.

Most biologists, I suppose, are accustomed to treat of living organisms as if they were simple physical masses of matter exhibiting their peculiar phenomena solely on account of their peculiar organization, including under that term molecular arrangement of the protoplasm as well as molar organization of the body of the individual. This conception involves the hypothesis that the peculiarity of the phenomena is to be accounted for by difference in kind, state, condition or structure of the component matter of the body.

Starting with such a conception, let us examine the phenomena and discover of what they consist.

CLASSIFICATION OF VITAL PHENOMENA.

In order to distinguish the phenomena of the organism from other phenomena and to restrict our attention, let us call the peculiar visible phenomena of an organism vital phenomena.

Vital Phenomena may be divided into three groups, according to the relation they bear to mode of existence.

A. When the question is: *What organisms are?* the phenomena described in the answer are found in the sciences of Botany, Zoology, Anatomy, etc.

B. When we ask: *What do organisms do?* the phenomena are described under the names of Physiology, Physiological Chemistry and Psychophysics.

C. When we ask: *What do organisms become?* the replies are found in Paleontology, Embryology, Evolution and Psychology.

This third group (C) of phenomena, because they are modes of becoming different and in a peculiar sense arise or are generated, may be called genetic phenomena.

The other two classes (A and B) may be left out of discussion for the present, because their relationships to ordinary physical phenomena are sufficiently distinct and evident.

The *Genetic Phenomena* of organisms are of, at least, three kinds; they are described under the scientific categories of

C^1 *Metabolism*,
C^2 *Development*,
and C^3 *Evolution*.

In the phenomena of each of these three categories there are two elements, viz.: (1) a something which preserves its identity and integrity during the phenomena, which may be designated by the symbol x; and (2) a something which arises during the phenomenon and remains as an increment to the first; this may be represented by y.

C^1. In Metabolism x stands for the matter flowing into the organism from without, and constitutes the physical basis of the organic body at any particular moment of its

existence; y is the complex and instable chemical union of the elements, set up in anabolism, which represents a definite quantity of potential chemical energy, that may be set free when the substance falls back into the more stable equilibrium of its previous condition, by processes of katabolism, or final decay.

C^2. In Development x is the vitalized protoplasm and other forms of the organized material basis of the organism; and y is the differentiation of cell, tissue and organ, or what, in general, is described by the term organization of the body of the organism.

C^3. In Evolution x is the individual organism, at any particular moment of its existence, which lengthens out by processes of generation into a series of successive individuals; and y is variation, when a single individual is considered, or divergence, when the series is considered, of both form and function, and results in 'modification of characters' and 'origin of species.'

The genetic phenomena in these three categories form a series in which y of the first becomes x of the second, y of second becomes x of the third; and thus y of the third seems to be the direct outcome of the matter taken in and appropriated in the metabolic process at the beginning of the series. This inference would follow were it not for a second fact, viz.: that the first group of phenomena never (according to present knowledge) takes place except when the matter flows into a *living* organism. This fact proves that the matter, *except for the action of the living organism*, would not metabolize, but would be simply aggregated to the previous mass of the organism, in the same condition as when it met the organism. Thus it becomes evident that metabolism is a *function* of the organism upon receiving the increment of inert matter; and going on to the second category we likewise discover that the organizing of the matter is a function of the living organism; and still further on it is evident that the variation and the divergence of characters in evolution are functions of living organisms alone.

In each case the phenomena are alike for like conditions of *previous* living organism, but they are unlike for like conditions of both the material medium and the material additions derived from without the organism. Hence it is proper to say that the determination of the genetic phenomena may be traced directly to a previous living organism, always present and active, and not to the conditions of the materials without at any particular moment of the process.

NATURE OF AN ORGANIC BODY.

This brings us to the consideration of another problem: What kind of a thing is this organic body which exhibits such genetic phenomena?

Tait tells us that "In the physical universe there are but two classes of things, matter and energy." He has further elaborated the proposition in the following words: "Energy, like matter, has been experimentally proved to be indestructible and uncreatable by man. It exists, therefore, altogether independently of human sense and human reason, though it is known to man solely by their aid."

Again, in the Newtonian formula we have the following proposition about matter in general, viz.: "Every body continues in its state of rest or of uniform motion in a straight line, except in so far as it is compelled by force to change that state." With these definitions in our minds, what answer can be given to the question: Is a living organism an inert body or mass of matter? and second: Is its integrity and individuality determined by a compelling force? In forming a reply we note the following particulars:

1. The matter of a living organism, as well as its form or configuration, is constantly undergoing change, while its integrity, identity and individuality persist.

2. The atomic matter which flows into the organism in metabolism suffers change, both molecular and in mass, without interfering with the continuous operation of the genetic phenomena of the organism as a whole.

3. The energy which is added to that of the organism by way of this acquired matter does not determine the course of the genetic phenomena, since, as has been said, the same matter behaves differently as it enters different organisms, and different matter is made to behave according to the law of the organism which it unites with.

4. The thing transmitted from parent to offspring, through which alone we are able to trace the determining power of the genetic phenomena in each case, cannot be matter alone, for matter is in itself inert; as Maxwell tells us: "We are acquainted with matter only as that which may have energy communicated to it from other matter, and which may, in its turn, communicate energy to other matter. Energy, on the other hand, we know only as that which in all natural phenomena is constantly passing from one portion of matter to another." ('Matter and Motion,' p. 165, 1878.)

5. Hence it follows that that which determines the individuality of the genetic phenomena of a living body, constitutes the integrity of the organism as distinct from a mass of matter, and preserves its identity through all the changes it undergoes, is energy, not matter.

6. A living organism physically behaves, not like an identical mass of matter, but like a stream of matter slowly entering and departing from the field of some continuous, identical form of energy. It behaves like a magnet, or a heated body, the phenomena exhibted by which are temporary and determined by what is called a particular form of energy resident for the time in the mass, and not determined by the particular materials, or arrangement of materials, of which the body is composed. Whenever the non-living matter from outside enters the living organism it exhibits for the first time the vital phenomena, and when it passes out of the field of the organism these peculiar phenomena cease and are not set up again till the matter comes again into the field of a living organism. Thus the physicist explains the color of an opaque object, not as the property of the material body as such, but as a phenomenon produced by the reflection of light energy by the body. The matter has color only as illuminated from without by light energy.

A GENETIC FORM OF ENERGY.

This train of analysis leads to the recognition of a *genetic form of energy*, on the principle of classification used in physical science. The physicist already recognizes the three forms—chemical, molecular and molar energy. The basis of that classification is the distinction between the three kinds of material units whose relation to each other, in each case, is disturbed in the phenomenal expression of energy of the several forms. Chemical energy is expressed when the relation of atoms changes. Molecular energy is the form of the energy when molecules change their relations; and it is molar energy which is exhibited when bodies or masses of matter change their positions in relation to each other. The genetic phenomena, above described, differ from the phenomena of each of the three classes named in that they concern changes of relation of living organic bodies only. It seems, therefore, appropriate, on this basis of classification, to speak of genetic energy as a fourth form of energy of equal rank with the chemical, molecular and molar energies of the physicist.

The recognition of this peculiarity of genetic energy gives at once rational meaning to such terms as doing, varying, acquiring, etc., which are appropriate when ap-

plied to organisms, but have only figurative meaning when applied to any other of the classes of matter or material bodies.

When a living organism is compared with a mechanical engine we note, first, that the work done by the machine is all accounted for by (*a*) the amount of coal burned and other potential energy entering in a similar way; and, second, that the construction (what Maxwell called the 'configuration of the mass') of the machine is accounted for by (*b*) the energy of the laborers expended in building it, together with (*c*) the potential energy of the bodies of matter used in the construction. But after balancing all these resources with the corresponding work accomplished, there still appears an item of cost of energy that has gone into the machine which must be represented also on the side of work done, viz.: (*d*) the designing of the architect.

Employing the same evidence which Tait deemed to be valid as a proof of the objective reality of energy, *i. e.*, the price of labor, we discover that the architect's labor must be accounted for in the work done, or else it was wasted energy. Furthermore, because, on the potential side of the account, we are able to sharply distinguish the designing from the constructing of the engine, we are authorized to reckon them as separate elements in the cost of the work done. It is to be noted that the particular kind of work performed by the architect, although it involves motion, is not strictly speaking any particular mode of motion, which may be measured in terms of horse-power, though measurable in terms of man-power. This may explain the reason why no account of his work is taken in estimating the potential energy of a machine. Nevertheless, all know that it requires the expenditure of energy which has a price, and is exerted only by a living organism.

If designing costs energy in the construction of a physical machine, is it not reasonable to look for a similar expenditure of energy in the construction of a living machine? In the phenomena of an organism we find the same groups of expenditure involved in the work done. These expenses are (*a*) the outside energy of heat, etc., of the food consumed; (*b*) the energy used in tissues exhausted in growth of construction; (*c*) that of the materials built into the structure with their potential energies abiding with them. These three, like the first three in machine construction, are accounted for on both sides of the equation. There remains to be considered the fourth group (*d*), viz.: that which corresponds to the designing of the machine and the potentiality of work consequent upon the designing. It will now be evident that, in the organism, that group of phenomena classified above as genetic constitutes this fourth group. The importance of, and the direction in which successful search for the source of genetic energy is likely to be made, are suggested by the following three facts. First the chief aim of biological investigations for the last half century has centered about the search for exactly this determining cause of the particular form of construction of organisms. This, in itself, is sufficient evidence of a prevailing belief that some such cause is to be naturally accounted for. Secondly, the main points of construction of a particular organism correspond to those of the parent organism, and not to anything in the material of which it is constructed, is sufficient to suggest the direction from which the energy comes which determines the construction. A third fact, that the three kinds of genetic phenomena (metabolism, development and evolution) are but elaborations of a single mode of operation, further points to the probability that the determining energy in question is the same for each. And all these considerations seem to lead directly to the conclusion, that some form of energy

must be predicated for the purely genetic phenomena of organisms, to account, that is, for the particular course of development followed by each species, and the particular course of divergence seen in each line of evolution. These conclusions seem to rest on as valid a foundation as that the visible colors of bodies are determined by light energy, or that the temperature phenomnena of physical bodies are determined by heat energy.

APPLICATION OF THE THEORY OF GENETIC ENERGY.

The *application of this theory* of genetic energy will become evident by attempting to distribute, in accordance with it, such a set of vital phenomena as are grouped together in Darwin's list of factors of evolution. In the 'Origin of Species' Darwin gave the following brief summary of the factors entering into the origin of species:

"These laws, taken in the largest sense, being growth, with reproduction; inheritance, which is almost implied by reproduction; variability, from the indirect and direct action of the external conditions of life, and from use and disuse; a ratio of increase so high as to lead to a struggle for life, and as a consequence natural selection, entailing divergence of characters and the extinction of less improved forms."

In this list eleven distinct factors are named. The question arises: What is the place of each in a system of vital phenomena in which variability is assumed to be the most fundamental of all?

The first factor, growth, in so far as it includes the material increase of the living body by the acquirement of matter from outside, and the reduction of it to a living state in metabolism, is one of the three forms of the fundamental genetic phenomena of variability.

The second factor, reproduction, is made up of two distinct phenomena: (*a*) the act of separating a living body into two or more distinct units, precisely called generation; and (*b*) the process by which the individual body is constructed after the fashion of its immediate ancestors, precisely called development. (*a*) The first, generation, is a mechanical phenomenon, not necessary or fundamental to all living; for it is not continually occurring, nor is it possible to occur till after some degree of development is accomplished. Hence, we may assume that it is an acquired phenomenon, *i. e.*, an expression of interaction between the genetic energy of the organism and the energies of the materials of construction and the environment. (*b*) The second, development, is the second form of the fundamental process above described, and is a necessary and universal characteristic of all living bodies. In Darwin's list the phenomena of development are partly included under the term growth, but material increase is not necessarily development. Metabolism is the acquirement and vivifying of inert matter by and into an individual organism; development is the differentiation of this mass into increased complexity of organization and function.

The third factor, inheritance, is the name for the law observed in the course of development by which the living body successively assumes the characters of the other body from which it was separated in generation. This law of repetition of the charters of ancestors cannot be a fundamental phenomena, because if it were strictly carried out no development would take place, and evolution results only by ignoring or transgressing the law of inheritance. We must assume, therefore, that inheritance is acquired, and in any series of organisms the law of inheritance became operative only after generation had arisen, and after the attainment of some degree of inequality had been reached between parent and offspring at the point of the act of generation,

i. e., the parent organism must be more developed than the germ cell it propagates. Inheritance is the completing of the development of the germ as a separate body after generation in the likeness of the parent from which it was separated.

The fourth factor, variability, is the primary genetic phenomenon of all organisms which, in a particular case, relatively or entirely ceases with the acquirement of inheritance in the course of development, or with the acquirement of fixation and permanence of specific form in evolution. It may be regarded as the most direct and characteristic expression of genetic energy.

The next three factors, ratio of increase, struggle for life and natural selection, are, as vital phenomena, of a purely secondary nature. Each of them implies the previous operation in the same organism of development, variation and the acquired phenomenon of generation. The discussion of these factors, though of extreme interest for other purposes, and by many considered to be the chief causes of evolution, do not appear as true determining causes of modification, but causes rather of removal from the field of such organisms as cease to continue in the race. This point was granted by Darwin, as Cope reminded his readers in 'Primary Factors of Evolution.' He held that natural selection does not induce variability; 'it implies only the preservation of such variations as arise and are beneficial.'

In making this statement it is important to note the distinction between variability and variation. A variation which is transmitted or preserved by natural selection loses its variability exactly to the extent of its preservation; therefore, natural selection checks variability.

The factors of indirect and direct action of the external conditions of life, and use and disuse, which in the Darwinian and Lamarckian theories of evolution play so important a part as causes of variation, cannot hold their place of supreme importance if, as is here maintained, variation be the fundamental factor in genetic problems. From this latter point of view the organism is conceived of, not as passively shaped by the conditions of environment, but as finding its fundamental function in actively occupying environment; and adjustment is a positive active process involving constant modification. Adjustment is, thus, a result of successful varying, rather than varying a result of maladjustment. From this point of view the factors, external conditions of life, use and disuse, struggle for life, and natural selection, though operative in determining the course of developmental construction of the organism, are effective in the way of limiting, restricting, giving permanence to and making hereditary the characters which arise by the direct activity of genetic energy.

The tenth factor, divergence of characters, which by Darwin was conceived of as the direct result of the action of the above factors, is, according to this view, a characteristic genetic phenomenon, taking place with greater or less rate of progress in every organic series. It is organic evolution, proper, and consists in the acquirement, by a particular living organism, in the course of its individual development, of characters not possessed by its ancestors. The first step in such evolution is necessarily variation.

This analysis of the Darwinian factors of evolution presents us with two classes of phenomena, viz.:

I. Three of them are fundamental phenomena exhibited by every living organic body, and it would appear (although not always visibly, still theoretically) continuously during active existence of the organism. These have been called genetic phenomena, because they are constantly resulting in genesis of changed state, condition or

form of the bodies exhibiting them. They are: (*a*) Growth, strictly speaking Metabolism; (*b*) Development (the second part of the factor called Reproduction by Darwin), and (*c*) Divergence of Character—properly Evolution—which includes the phenomena of variation.

II. The second group of factors are all of a secondary nature. They are: (*a*) the first part of Reproduction, *i. e.* Generation, which is seen in its simplest form in Mitosis, next in cell-cleavage, in which the process results in producing two more or less equal and similar parts; and only in organism of some degree of differentiation in structure does it result in true generation through the formation of immature germ-cells, which continue development along hereditary lines of generation; (*b*) Inheritance, which cannot take place till inequality between germ and parent is already attained at the time of generation, and the attainment of this inequality cannot be primitive; (*c*) Ratio of Increase; (*d*) Struggle for life, and (*e*) Natural Selection, none of which can occur till after generation and inheritance have resulted in the production of antagonistic individuals.

The fundamental genetic phenomena of the first group are related to each other, and therefore distinguished, in the same way as the fundamental phenomena of non-living matter are related and distinguished in chemical, molecular and molar groups. Metabolism pertains to changes in the molecular relations of the contents of a living cell; Development pertains to transmutations of the cellular contents (as cells, tissues and organs) of a living unit, *i. e.*, the organic individual; Evolution pertains to the modifications of the individual members of a genetic series of successive organisms. These three forms of genetic phenomena are alike in that they all consist in the modification or change in the mode of action or function of the body expressing them.

In Metabolism, molecules, which in normal chemical phenomena (not organic) have been at rest, or passing into or toward conditions of more stable equilibrium, in vital phenomena pass upward into more unstable combinations. I speak, of course, of the anabolic phenomena of metabolism.

In Development, bodies, which under the influence of physical forces would move toward a state of greatest rest and equilibrium, are in the living body actively engaged in changing position and overcoming resisting forces.

In Evolution, series of bodies, normally revolving in adjusted cycles of generational reproduction are slowly departing from the hereditary course of these cycles, and acquire new characters which their ancestors did not possess.

The recognition of the fundamental nature of this principle of varying, or transmutation, in living bodies not only ties together all the vital phenomena into a consistent system of correlated processes, but it brings their phenomena into a natural relationship to the normal phenomena of inorganic matter.

The path by which these conclusions are reached is not a new one, but is simply an extension of the same line of thought which a century ago led to the overthrow of the Cuvierian notion of species. The mutability of species was a necessary preliminary step in the formation of a clear notion of organic evolution. We must carry the idea one step further and recognize the essential *mutability of the organism.* As in the last century the whole classification of organisms was based on the theory that the species was an immutable unit, so at the present time the whole classification of biological phenomena is based on the assumption that heredity is a fixed immutable law. The principle of mutability must be recognized in the phenomena of development before we can rightly comprehend the laws of organic life.

Variability is the expression of the fundamental energy of the organism, and is not an irregular accident. Heredity is the expression of the acquired adjustment of the organism to the conditions of its existence. Mutable heredity sounds like a contradiction; so did mutable species a century ago; but it is only as heredity is mutable that evolution is possible.

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*THE MEASUREMENT OF SMALL GASEOUS PRESSURES.**

PRIOR to the invention of the McLeod vacuum gauge, the measurement of even moderately small gaseous pressures was difficult, and subject to large errors. The introduction of the McLeod gauge, however, early in the seventies, seemed to solve the problem. In its ordinary form, and for most purposes, this beautiful instrument admirably serves the purpose for which it is designed. But when *very* accurate measurements of pressures as small as a few millionths only of atmospheric pressure are desired, its performance is extremely unsatisfactory and vexatious. As is well known, the chief cause of the difficulty is the unequal and variable capillary depression of the two small columns of mercury, whose difference in height indirectly serves as the measure of pressure. Accurate measurement of this capricious difference obviously avails nothing.

Three or four years ago I was engaged in an investigation requiring frequent and simultaneous measurements of slight but different pressures in two large glass globes connected by a capillary tube. For this purpose I constructed and carefully calibrated two large McLeod gauges. The internal diameter of the mercury tubes was about three millimeters, and they were made from contiguous parts of the same glass tube selected for uniformity of bore. These gauges were often compared by measuring the same vacuum with both, but they rarely gave concordant results. Indeed, it was not uncommon at high exhaustions for one or the other of them to indicate a negative vacuum; that is to say, less than no pressure at all. The case of these two gauges is cited because of the opportunity they afforded for comparison. In prior work I had, like most experimentalists, used but one gauge, and, while always suspicious of its indications, had no means of knowing how large its errors might be.

The phenomenon which I next desired to investigate is the spontaneous evolution of of gas from glass and other surfaces in high vacua. For this purpose an accurate and entirely reliable means for measuring very small pressures was necessary, because I could not afford to wait months or years for the evolution of sufficient gas to be detected with certainty by the old gauges. To meet these requirements, I designed, constructed, and learned how to use, the modified form of McLeod gauge, which it is the purpose of this paper to discuss.

The diagram herewith shows the essential parts of my apparatus. The bulb A, of the gauge, is made conical in its upper part to avoid adhesion of gas bubbles when the mercury rises. This bulb holds about eleven pounds of mercury. B and C are the gauge head and comparison tube respectively. They are nearly twenty millimeters inside diameter, and are made from contiguous parts of the same carefully selected tube. D is the usual air trap, and E is a long glass tube, with flexible pure rubber connections to the lower end of the gauge stem and the mercury cistern F. The latter is mounted on a carriage G, which moves vertically on fixed guides. The height of the carriage is adjustable, at the upper end of its range of motion, by means of screw H, thumb-nut I and forked support K. The screw is pivoted to the

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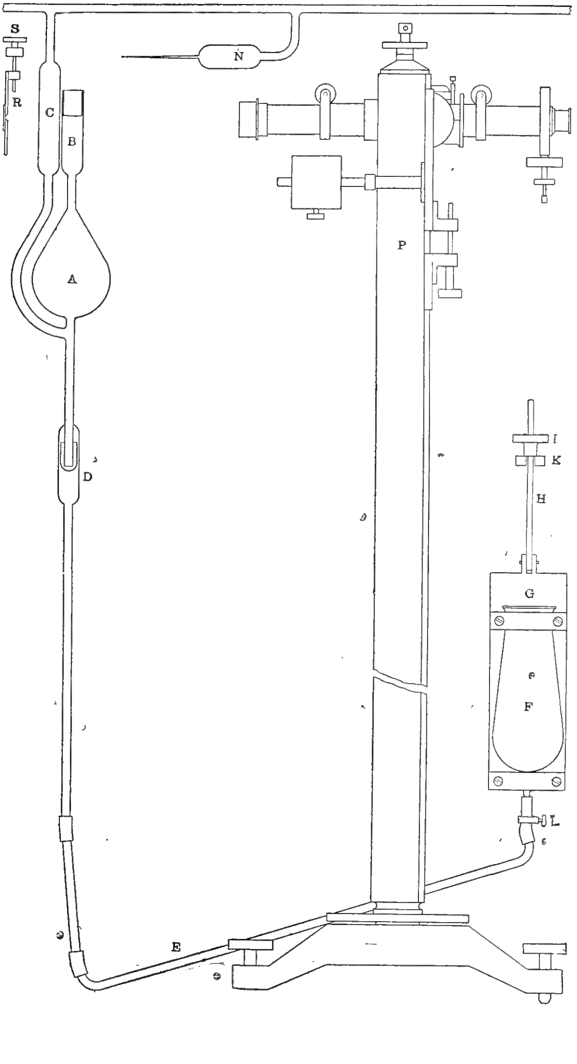
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carriage, so that it may swing out of the fork when the carriage is lowered. L is a pinch-cock with screw for regulating the flow of mercury, or stopping it altogether, while pumping out the trap D. N is a bulb containing phosphorus pentoxide, to keep the interior of the gauge and other parts of the apparatus perfectly dry. P is a very elaborate cathetometer for observing the mercury columns in B and C. This beautiful instrument has a revolving column with vertical scale, and vernier with miscrope, reading to hundredths of a millimeter. The eye-piece micrometer reads directly to hundredths of a millimeter, and the divisions on the revolving head of the screw are so open, that tenths of divisions are easy and certainly estimated by an experienced eye, thus permitting the micrometer to be read directly to thousandths of a millimeter. Of course the cathetometer is permanently located not as shown, but with the objective of its telescope equally distant from the axes of the tubes B and C, when it is alternately directed to them, and at such a distance that its micrometer readings correspond to a millimeter scale. The whole apparatus is located in a basement room, on a stone floor, whereby vibrations are reduced to a minimum.

The most important part of the gauge is the head B. The purpose of its great diameter is the reduction of capillary depression in its mercury column. But its size necessitates a very close approach of the mercury to its upper end, in order to reduce sufficiently its capacity. Yet the remaining space must be measurable by the cathetometer, with the utmost precision. Hence the glass must not be distorted by heating, and the closed end just over the mercury must be sharply defined. In constructing this part of the apparatus, I selected a piece of heavy tubing which would just slip inside of B, with the least possible clearance. One end of this tube was closed as squarely as possible by fusion, and then ground with fine emery and a suitable tool, to a convex spherical surface of a long radius. Care was taken to make the center of curvature lie in the axis of the tube, and the ground surface was left unpolished to facilitate observation. A suitable length of the closed end of the tube was then cut off, slipped into B, and both tubes were fused together at their open ends, as shown.

For calibrating the head B, a ground glass stopper with a capillary duct was fitted to its neck, before the latter was sealed to the bulb A. The head was then filled with mercury by boiling, thus completely filling the small space between its wall and the cap. After cooling, the stopper was inserted to expel all excess of mercury, and the whole weighed. Next the head was emptied, and the mercury in the annular space distilled out. Again the head was very nearly filled with mercury, without allowing any to get into the annular space, and weighed as before; and the space between the top of the mercury and the convex end of the head was very carefully measured by the cathetometer. This process of weighing and measuring was repeated several times, with less mercury each time. Thus the capacity of a vertical millimeter of the head was ascertained, as well as the capacity that would remain, if the top of the meniscus of mercury just touched the convex end of the gauge, above it. Finally the neck was sealed to the bulb A, and the capacity of head, neck and bulb combined was found by weighing them empty, and again filled with mercury.

For lighting the top of each mercury colemn, a narrow horizontal slit in an opaque screen, R is used. The slit is covered with a strip of ground glass and obliquely illuminated by an electric lamp. The screen and slit are vertically adjusted by a thumb screw S. The heat of the lamp is prevented from reaching the mercury col-

umns and head B, by a thick screen. This is very necessary.

In order to get the best results from the apparatus, many precautions are necessary. After filling A and B with mercury, time must be allowed for the compressed gas to cool. The effect of changing barometric pressure is nearly eliminated by so regulating the quantity of mercury in F, that its surface is in the small tube at the bottom of the cistern, when the gauge is properly filled. Its area is then very small, as compared with that in B and C. The height of the meniscus in both tubes is easily adjusted sensibly equal, by a little manipulation. I *always* raise the mercury above the point at which readings are to be taken, and then lower it, so as to read on a falling meniscus. This is highly important.

Some trouble was occasionally experienced at first, from electro-static induction between the mercury in B, and the glass above it. This was shown by distortion of the miniscus when it was brought very near the glass. The difficulty was partially, but not wholly remedied by putting mercury in the outside open end of the gauge head, and connecting it by a flexible conductor with the mercury in the cistern F. A complete remedy was effected by moistening the inside of the gauge head with a dilute solution of phosphorus pentoxide. This became completely dried by the anhydrous phosphorus pentoxide in N, but was, of course, not dehydrated, and hence always remains conducting, and dissipates the static charge.

Large pressures, up to a thousand millionths or more, are readily measured with this apparatus, by finding with the cathetometer the distance between the mercury in B, and the end of the head above it; from this is quickly calculated the necessary multiplier for the number of millimeters difference in height between the columns B and C, also measured by the cathetometer, in order to express the result in millionths. For very small pressures, the micrometer wires are set at such a distance apart as to give a convenient constant (usually 2), and the column in B is adjusted this distance away from the glass, careful allowance being made for the thickness of the wires. Then the micrometer is used for repeated measurements of the difference in height of the mercury in B and C. The disturbing effect of *bias* is entirely eliminated by giving the micrometer screw a partial turn after each reading. Thus the next measurement is made without any knowledge of its difference from the preceding one, until the eye is removed from the telescope.

In my early experience with the apparatus, unusually careful measurements of very small pressures were often made, to determine how far its indications might be relied upon. In this connection I quote as follows from my notes, under date of February 20, 1895, concerning the last one of a series of pressure determinations:" Following is the last reading in detail, showing the extreme accuracy of these measurements:

	.432 M.	.438 M.	.441 M.
	.441 "	.4335 "	.429 "
	.4335 "	.4275 "	.4305 "
	.426 "	.450 "	.435 "
	.4335 "	.4425 "	.432 "
	.4395 "	.432 "	.4185 "
	.4305 "	.435 "	.435 "
	.441 "	.432 "	.453 "
	.435 "	.4215 "	.4425 "
	.435 "	.4245 "	.438 "
Means......	.4347 "	.43365 "	.43545 "

"Mean of all the readings, .4346 M.

"Readjusted zero point of micrometer before each reading of each set. Partially emptied gauge and readjusted capillary depression before each set of readings. The first series has no known source of error. The second and third series were made during wind squall, and surface of mercury was often tremulous. In the

third series, capillary depression was perceptibly though very slightly unequal, in direction to make readings too high."

In the above quotation 'M' means millionths of atmospheric pressure. The calculated probable error of the thirty readings taken together, is only ninety-two hundredths of a unit in the third decimal place; that is to say, less than a thousandth part of a millionth of atmospheric pressure. The probable error of the three mean results, considered as single readings, is only eleven hundredths of a unit in the third decimal place of millionths. The net result may be expressed as follows, in terms of atmospheric pressure: Considered as thirty measurements:

$$0.000\,000\,434\,60 \pm 0.000\,000\,000\,92.$$

Considered as three measurements:

$$0.000\,000\,434\,60 \pm 0.000\,000\,000\,11.$$

Here we have the measurement of a total quantity of less than half a millionth of atmospheric pressure, with a probable error of only about a fifth of one per cent. of the quantity measured.

To show how small is the effect of variable capillary depression in the large mercury columns, the following measurements were made July 25, 1897. No correction was made of accidental capillary differences, but the columns were always observed with a falling meniscus. The zero of the micrometer was freshly adjusted for each reading, and before each of the six sets of readings the mercury was lowered and then readjusted to the proper height in the gauge head.

	M.	M.	M.	M.	M.	M.
	2.210	2.203	2.209	2.198	2.198	2.202
	.204	.195	.202	.203	.204	.198
	.209	.198	.204	.208	.200	.196
	.203	.204	.210	.200	.196	.208
	.203	.192	.202	.198	.196	.203
Means	2.2058	2.1984	2.2054	2.2014	2.1988	2.2014

Calculating the probable errors we have:

Six mean readings......2.20187 M. ± 0.00073 M.
All readings...........2.20187 " ± 0.00059 "

The effect of not equalizing the capillary depression is very apparent when these results are compared with the earlier ones quoted. But on account of increased skillfulness of observation, due to long experience, the individual readings of each set are more uniform than before; so that the net result is better.

In this example, we have the measurement of about two millionths of atmospheric pressure, with a probable error of only one part in three thousand, of the quantity measured.

From the foregoing, we may safely conclude that with the apparatus described, small gaseous pressures may be easily measured, with a probable error of less than a thousandth part of a millionth of atmospheric pressure.

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SOME THOUGHTS CONCERNING THE TEACHING OF CHEMISTRY.

IN the preface to a short set of 'Notes Upon Qualitative Analysis,' recently published, I made use of the expression: "There is small doubt that, were it not for the expense of printing, every teacher of chemistry would use a text-book made by himself with either pen or scissors."

In a review of the little book which afterwards appeared in one of the foreign journals, the critic referred to the above sentence, with the added remark: 'Sad, indeed, if true!' He who wrote the criticism is a distinguished chemist, for otherwise his opinions could not find place in so eminent a journal; but the thought crosses me: Is he a teacher? There is a tremendous difference between the specialist who never enters the class-room and the trained instructor who but rarely leaves it.

A man may rank in the highest grade as a scientist, and yet be nothing of a teacher; he may be skillful to the last degree in map-

ping out a line of inquiry tending towards the solution of one of nature's mysteries, and yet be a mere tyro in the art of imparting his knowledge to a class of students. It was the writer's fortune, when a student, to have for an instructor a man of world-wide reputation; but, great as the man was as an investigator, he was a very indifferent 'professor.' It has been my privilege from time to time to attend lectures given to undergraduates by men who, although not professed instructors, stand, nevertheless, at the very forefront of their respective professions; and it has greatly interested me to note how different their mode of presentation commonly is from that followed by men more in the habit of meeting an audience of such a character and more familiar with its peculiarities and methods of thought.

It is trite to say that teaching is a distinct specialty, and that to teach well is the gift of comparatively few; but the fact remains pertinent, notwithstanding its triteness, and is worthy of consideration.

To return to the quotation, I would say that it was written in the light of over twenty-two years' class-room experience, and with what I believe to be a pretty full knowledge of the wants of the average student.

I cannot by any means agree with the critical comment: 'Sad, indeed, if true!' It is unquestionably true that every teacher would find his work more easy of accomplishment could he use a text-book of his own arrangement; nor is there any element of sadness connected with this fact. The composition of classes and the arrangement of courses cannot fail greatly to modify the treatment of the same subject, as presented at different institutions; and it would be small praise, indeed, for the instructor were it said of him that he stuck to his text-book literally, even though such book were of unsurpassed excellence. It is the class-room enlargement of, or variation from, the text that is of real value to the student, for the points thereby brought out are the ones which he cannot readily secure by private study. At a New York preparatory school, where the methods of instruction were as peculiar as they were excellent, the writer remembers that the few text-books permitted were mostly selected because of their poor qualities, in order that criticism thereof might make a deeper impression upon the class. Of course, it would be easy to carry such a system too far, especially when dealing with advanced subjects; but if the instructor be worthy of his position he cannot, and should not, be entirely satisfied with the matter exactly as it is presented in the best text-book ever written. He should have his own way of presenting his subject, or else he will fail to hold his classes.

"An ill-favored thing, sir, but mine own,"

is a motto that might fit the method of many a successful teacher of chemistry, for there are but few sciences whose elementary teaching calls for so much good judgment in placing the subject-matter in a form easily grasped by the beginner and in selecting illustrations from sources that are both homely and apt. When I said that, were it not for the expense of printing, a man would prefer his classes to use a book of his own making, I wish to be understood as holding that, in order to have such a book of the highest order of usefulness, it must be written for his classes, and his alone. For it is a fact that a man writes for his private use a very different and usually a much more effective book than the one he dares to offer the public. It would appear that books are largely written to please the critics; and if they be so constructed as to pass the ordeal of 'review,' it is entirely a secondary matter whether or not the student is able to readily

grasp their meaning when starting from his point of view.

It being, of course, admitted that chemistry should be so taught as to have its principles firmly retained by the student, the instructor should endeavor to place himself in the student's position and strive to see things from his standpoint. It is immaterial how scientific the arrangement of the course may be if such arrangement does not follow the mental drift of the average learner and appeal to his sense of general fitness. It is for that reason that I cannot sympathize with a separation of the oxides of arsenic by an interval of seventy-five pages from the other compounds of the same element, as is done in one of our best text-books. Such separation may suit the views of the distinguished author and his brother chemists, but the book is not written for them; it is intended for the use of beginners, and beginners do not look at the subject in that apparently disjointed way.

Another difficulty with many of our text-books is that they are much too full during the early portions of the course. They deal with expansions of, and exceptions to, topics at a period when the topics themselves are fraught with entirely new ideas to the student.

Take, for instance, the question of 'valency.' If my experience goes for anything, it is better to allow the beginner to conceive valency as a definite constant for each element, and then at a later stage, after considerable experience with things chemical has been acquired, the subject may be brought up again and more extensively discussed.

Again, let us suppose that the student is at work upon the subject of 'Phosphorus.' Almost the first fact he learns is that phosphorus is attacked by oxygen with exceeding readiness, and that an oxide of the element results.

Is it wise, therefore, to insert in the text that 'phosphorus is incapable of uniting with oxygen if the gas be perfectly pure and free from aqueous vapor?' Would it not be better to allow the beginner to become as familiar as possible with the chemistry of ordinary conditions before venturing into those dimly lighted regions where 'chemical purity,' 'perfect dryness,' 'exceeding heat' or 'exceeding cold' are the disturbing factors?

The student tends to hold the instructor responsible for all irregularities in the science, and, as a beginner, he resents ambiguity. Exceptions and amendatory comments both confuse and discourage him. The time comes later on when to note the peculiar character of this substance, or the exceptional behavior of that, may be of real interest to him; but the establishment of such an interest is a matter of slow development, and care should be taken during the early stages of instruction that great masses of heterogeneous facts be not so piled together as to cause no growth at all.

W. P. MASON.

RENSSELAER POLYTECHNIC INSTITUTE,
TROY, N. Y., May, 1898.

PROFESSOR SCHENCK'S RESEARCHES ON THE PREDETERMINATION OF SEX.*

IN view of the fact that Professor Schenck's conclusions as to the power of artificially determining the sex of offspring have served as a nine-days' wonder to some of the lay papers, it seems advisable to lay before our readers a plain statement of his argument, taken without comment from the pamphlet which he has just published.† It opens with the statement that it is impossible to command natural processes, but possible by scientific means to exercise a

* From *The British Medical Journal.*

† *Einfluss auf das Geschlechtsverhältnis.* Von Dr. Leopold Schenck, Professor an der k.k. Universität und Vorstand des Institutes für Embryologie in Wien. Magdeburg: Schallehn and Wollbrück. 1898.

more or less effectual influence upon them, in order to extract from them the best possible results. His essay falls into three parts—a summary of the writings of his predecessors, an account of his own researches and deductions, and finally a description of the method of treatment he has devised, with illustrative cases.

In the development of an embryo the generative organs are at first indifferent—hermaphrodite; in the further process of growth one set develops while the other atrophies. This tendency must be predetermined from the time of fertilization, for each cell formed from the ovum must have sexual characters, since these are not confined to the generative organs, but appertain to the whole body. The readiness with which an ovum can be fertilized depends upon its position in the ovary, the thickness of its envelope, etc., and these may also have a bearing on the question of sex. In other words, the predetermination may precede fertilization, and of this confirmation is found in the development of bees and in the production of male and female flowers by plants under different nutritive conditions. In this connection Professor Schenck enunciates and discusses at considerable length the views of previous writers. He points out that the male sex preponderates to a definite though slight degree in the total number of births, and that the sex of a child is more likely to be that of its older parent. He pays particular attention to the theory of crossed sexual heredity, by which each sex tends to propagate the other. Thus if the sexual power of the male be greater a female offspring is more likely to result, and *vice versa*. This theory is threshed out most thoroughly and with abundance of quotations and examples ; in the end Professor Schenck practically accepts it, and makes use of it in his further work. With regard to the influence of environment upon sex, he quotes Robin's statement that in warm climates females preponderate, in cold and unfavorable, males. Born also showed that 95 per cent. of artificially fertilized frog's eggs hatched out as females, this being an effect of nutritive conditions acting after fertilization. Thury's researches are fully analyzed, and are stated to have originally called Professor Schenck's attention to the subject. Thury found that cattle fertilized at the beginning of 'heat' threw more females, at the end more males. This he explained by the degree of ripeness of the ovum, but Professor Schenck accounts for it on the crossed inheritance theory, the sexual power of the female being at its greatest at the end of the period of rut. This part of the work is summed up in the statement that the sex of offspring largely depends upon the state of nutrition of the parents, particularly that of the mother during pregnancy. During this period the difference between intake and excretion represents the food of the embryo, and hence requires special attention. The temperature is slightly raised owing to oxidation processes, which entail a considerable consumption of red blood corpuscles and consequent diminuation of hæmoglobin.

The second section begins with the enunciation of the fact observed in domestic animals and in insects that the better the mother is nourished the more females she produces, the number of males remaining practically constant. This influence upon the fœtus *in utero* has received but little attention from the practical point of view, and Professor Schenck consequently set out upon a series of observations based on the theory of crossed sexual inheritance. He first investigated the excreta, and particularly the carbohydrates of the urine. The presence of a certain amount of sugar, which is commonly recognizable by the phenyl-hydrazine test in perfectly normal individuals, indicates incompleteness of the oxidation pro-

cesses, whereby a certain quantity of heat is lost to the body. This physiological output of carbohydrate is in the male sex most marked during the period of growth—that is, between the ages of 14 and 19. In women there is no corresponding increase, but small quantities may appear in the urine before and after menstruation, while Iwanoff and others have shown that glycosuria is common in pregnant and parturient women. Now the amount of sugar normally excreted is equal in men and women, but more significant in the latter owing to the lesser activity of their metabolic processes. For the perfect ripening of the ovum it is necessary that oxidation shall be perfect—that is, that no sugar shall be left unburnt. Where there is a remainder of unburnt sugar the ovum stands a chance of being less ripe, and less well nourished. Hence the properties of its protoplasm are less well developed, and by the theory of crossed inheritance it is more likely to produce a female child. On the other hand, when the urine is free from sugar the ovum can attain perfect development, and give rise to male offspring. It is upon this cardinal principle that Professor Schenck's theory is based. He holds that a prolonged course of appropriate nourishment both before and after fertilization will tend to the conception of male children only.

The next question is of the means to be adopted to ensure this end. If a male child is desired, and the maternal urine contains no sugar, but abundance of reducing substances (particularly the lævo-rotatory glycuronic acid), he allows impregnation forthwith. If, on the other hand, sugar is present it must be removed, and the reducing substances increased before fecundation may take place. It is found that the urine of a woman pregnant with a boy contains more reducing substances than that of one with a girl. We need not enter into the details of the diet recommended, beyond saying that it contains much proteid, which seems to be required by a male embryo.

Finally Professor Schenck gives what may be called his clinical results. He quotes numerous cases to show that the bearing of female children is associated with glycosuria. In such instances he recommends a diet comprising plenty of proteid and fat, and as little carbohydrate as can be tolerated; this must be taken for two or three months before and three months after impregnation. He gives one example in which six boys were born in succession under this treatment, and a girl immediately it was relaxed; and others in which boys were born after repeated births of girls before the treatment. In all, out of seven recorded cases, six were successful. He concludes that the nutrition of the mother plays a most important part in the determination of sex, and that in countries where much flesh is consumed there is a marked preponderance of male children. This can be imitated artificially, but it is far more important to ensure the completeness of oxidation processes in the body. As long as the combustion of the food is perfect, and the urine is totally free from sugar, the exact amount of meat consumed is of secondary importance. The birth of male children can thus, in certain cases, be predetermined, but the voluntary production of girls is a problem as yet unsolved.

CONVERSAZIONE OF THE ROYAL SOCIETY.

THE first of the annual *conversaziones* of the Royal Society was held on May 11th, in the Society's rooms at Burlington-house, the guests being received by the President, Lord Lister.

The London *Times* states that there was the usual exhibition of objects, apparatus, processes, and experiments illustrative of some of the most recent advances in scien-

tific research. The exhibits seemed on the whole more abundant than usual, while an unusually large proportion were of a character that could only be understood by specialists, or at least by actual inspection under expert guidance. As might have been expected, the results obtained by the various parties who went to India to observe the recent eclipse of the sun were particularly prominent, and attracted considerable attention. These exhibits were lent by the Permanent Eclipse Committee and conveyed the impression that substantial results had been achieved by the parties which went to India. From the Astronomer-Royal there were six photographs of the corona, showing the results of various exposures. Sir Norman Lockyer showed several photographs illustrating the eclipse and the expedition to Viziadrug. Some of these were photographs of the observing station, its party of observers, and some of the instruments employed. Another series illustrated some of the results obtained, including enlargements comparing the spectrum of the chromosphere taken at the beginning of totality with that taken eight seconds after the end of totality. Other eclipse photographs were shown by Captain Hills, Mr. H. F. Newall, the Astronomer-Royal for Scotland, and the Eclipse Committee of the British Astronomical Association, which had parties at Buxar and Tahni.

Professor Oliver Lodge exhibited some results of his experiments in space telegraphy, in which, under the requisite conditions, the most remarkable sympathy was manifested between two condenser circuits placed at a distance from each other; with enough copper in each circuit there is no assignable limit of distance. Professor Lodge, in conjunction with Dr. Alexander Muirhead, also showed experiments in Hertz-wave space telegraphy between a couple of signalling stations, one at the far end of the library, the other in the Secretary's room. These two exhibits, especially the former, were perhaps the most suggestive and attractive in the rooms. The former especially is almost uncanny in its mystery, and both are capable of being turned to important practical uses—communication, say, with outlying islands and lightships. Professor H. Callendar showed a new electrical recording apparatus, which has been in use for some time at McGill College, Montreal, and which may be applied to a great variety of scientific and practical purposes. Mr. Orme Bastian's electric current meter seemed to suggest the possibility of really delicate and accurate measurement. Interesting also were Mr. K. J. Tennant's photographs of electric discharges.

Of special interest were the charts, sections and specimens, illustrating some of the results of the investigations carried on in the Atoll of Funafuti, South Pacific, shown by Sir W. J. L. Wharton and Professor Judd on behalf of the Coral Reef Committee of the Royal Society. It will be remembered that the expedition in H. M. S. Penguin in 1896 was not very successful, while that of 1897 under Professor David succeeded in boring to a depth of 698 feet. This year a third expedition is going out and hopes to reach a greater depth.

As usual at recent exhibitions the Röntgen rays held a prominent place. Mr. Mackenzie Davidson showed an apparatus very ingeniously arranged to localize exactly any particular object, such as a bullet. Mr. Campbell Swinton showed a Röntgen ray camera with a pin-hold instead of a lens, also very powerful cathode-ray lamps and some experiments on the circulation of the residual gaseous matter in Crookes tubes. Mr. Wimshurst exhibited an improved apparatus for holding and for the excitement of Röntgen-ray tubes. One beautiful demonstration was that of Mr. C. T. R. Wil-

son, showing the production of cloud by the action of ultra-violet light, suggesting an explanation of the blue in the sky. Professor Hele-Shaw's delicate experiments on the flow of water deserve mention. They are of practical moment also, as are Mr. T. Andrew's micrographic illustrations of deterioration in steel rails, indicating the microscopic structure and composition of the most enduring and safest rails. Professor Roberts-Austen showed a complete installation of apparatus for the microphotography of metals designed for Sir Andrew Noble for use at Elswick Works, also apparatus to illustrate M. Daniel Berthelot's interference method of measuring high temperatures. It consists of an optical interference apparatus in which a beam of light is divided by a thinly-silvered mirror and passed through two tubes. In one of these tubes air is rarefied by heat and in the other by exhaustion, and when the rarefaction is equal in both tubes colored interference bands appear. As the degree of exhaustion in one tube can be measured by a manometer the unknown temperature is readily found. Mr. Horace Seymour, Deputy-Master of the Mint, exhibited a case of bronze Jubilee medals beautifully colored by a method, borrowed from the Japanese, which marks a new departure in medal work in this country. Mr. J. E. Stead sent some remarkable specimens of iron and steel, showing crystalline structure developed at 750°C., the temperature at which the magnetic change in iron takes place. They proved that their peculiar polygonal structure could be produced without the presence of a cementing material between the joints, and showed clearly the existence of allotropic forms of iron. Professor Ewing exhibited a magnetic balance for permeability tests of iron. It is a new apparatus designed to afford an easy means of judging of the magnetic quality of iron or steel, with special reference to its suitability for use in dynamo magnets.

An attractive exhibit was that of Mr. Joseph Goold's experiments in relation to resonance, which were harmonics, sub-harmonics, and compound harmonics illustrated by the action of forced vibrations in paper discs, thin metal plates, etc.; also vibration-tops, which spin by contact with vibrating surfaces, and vibrating dust-heaps bursting into whirling nebulæ and condensing into gravitating systems of circular mounds.

Those who attended the meeting of the British Association last year were interested in Professor Poulton's Canadian insects and Dr. Armstrong's colored photographs of the Yellowstone Park. The series of models illustrating the composition of vertebræ in the various groups of vertebrata, exhibited by Dr. Gadow and Mr. W. F. Blandford, were highly instructive. The 'naturographs' shown by Mr. R. B. Roxby were beautiful specimens of Dr. Selle's process of photography in natural colors.

Every one was naturally interested in the exhibit by Professor Herdman and Professor Boyce of healthy and unhealthy oysters, showing the causes of coloration and the connection between oysters and disease. The exhibit by the Marine Biological Association of the adaptation of marine animals to their environment, illustrated by living examples of the higher crustacea, was highly instructive and interested many. There were several other interesting biological exhibits and demonstrations. It is impossible even to mention many other exhibits, some of them of at least equal scientific importance to those referred to.

During the evening, besides Sir Norman Lockyer's eclipse exhibit, shown by means of the electric lantern, Dr. Sorby showed some cleverly mounted slides illustrating marine animals.

ZOOLOGICAL SOCIETY OF LONDON.

THE sixty-ninth Anniversary Meeting of this Society was held yesterday at their offices 3 Hanover Square W. The chair was taken at 4 p. m., by Sir William H. Flower, K.C.B., F.R.S., President of the Society.

After the Auditors' report had been read, a vote of thanks accorded to them, and other preliminary business had been transacted, the report of the Council on the proceedings of the Society during the past year was read by Mr. P. L. Sclater, F.R.S., the Secretary. It stated that the number of Fellows on the 31st of December, 1897, was 3,158 showing an increase of 60 during the past year. The number of Fellows' names upon the Society's books was at that date larger than it had been at any period since the year 1885.

The occurrence of the Queen's Diamond Jubilee in 1897, together with the very favorable weather experienced during the summer and autumn of that year, had drawn a large number of visitors to the Society's Gardens, and the total income of the Society had consequently reached the large amount of £28,713, being £1,631 more than in 1896, and greater than that of any year since the year 1884.

The ordinary expenditure of the Society for 1897 had amounted to £25,329, which was an increase of £1,541 over that of the year 1896. Besides this a sum of £2,375 had been paid, and charged to extraordinary expenditure, having been mainly devoted to new works and new buildings.

A further sum of £1,000 had been placed to the Society's Deposit Account (which now amounted to £3,000), and a balance of £1,074 had been carried forward to the benefit of the present year.

The usual scientific meetings had been held during the year 1897, and a large number of valuable communications had been received upon every branch of zoology. These had been pnblished in the annual volume of *Proceedings*, which contained 1,013 pages illustrated by 57 plates, Parts 3 and 4 of the 14th Volume of the Society's Quarto.

Transactions had also been published in 1897. The 33d Volume of the *Zoological Record* (containing a summary of the work done by zoologists all over the world in 1896), edited by David Sharp, F.R.S., had been likewise published, and issued to the subscribers in November last.

The Library, containing upwards of 20,000 volumes, had been maintained in good order throughout the year and had been much resorted to by working naturalists. A large number of accessions both by gift and purchase had been incorporated into it.

The principal new building opened in the Society's Gardens in 1897 had been the new ostrich and crane-house which had been commenced in autumn of 1896. The final balance due to the contractors for its erection (£1,188) had been paid to them in 1897 and charged to extraordinary expenditure.

During the past summer also a new glass-house for the reception of the Society's collection of tortoises had been built, adjoining the reptile house, at a total cost of £464, and likewise charged to extraordinary expenditure. This amount, however, had been lessened by the sum of £150 which the Hon. Walter Rothschild, F. Z. S., who is especially interested in these animals, had kindly contributed towards it. A third new building erected in the gardens during the past year, and recently opened to the public, was a new lavatory which had been built near the refreshment rooms specially for the accommodation of visitors resorting to that department of the gardens.

Since the last anniversary a serious loss had been caused to the Society's staff by the death, on the 7th of May last year, of Mr. A. D. Bartlett, for 38 years Superintendent of the Society's Gardens. In the report

made to the general meeting on the 19th of May last the Council had already recorded their deep sense of the services rendered to the Society by the late Mr. Bartlett during the long period for which he had held his post, and of their full appreciation of the skill, energy and faithfulness with which he had discharged the multifarious and difficult duties of his office. On the present occasion the Council could do no more than repeat the sentiments expressed at that meeting, which they were sure would be fully concurred in by all the Fellows of the Society. The vacancy thus caused had been filled by the appointment, as Superintendent, of Mr. Bartlett's second son, Mr. Clarence Bartlett, who had been in the Society's service for 36 years as his father's assistant.

The number of visitors to the Gardens in 1897 had been 717,755, being 52,751 more than the corresponding number in 1896.

The number of animals on the 31st of December last had been 2,585, of which 792 were mammals, 1,362 birds, 431 reptiles and batrachians.

Amongst the additions made during the past year, 17 were specially commented upon as being of remarkable interest and in most cases new to the Society's collection.

The report concluded with a long list of donations to the Menagerie received in 1897.

A vote of thanks to the Council for their report was then moved by Sir John Lubbock, Bt., F.R.S., seconded by Mr. R. Lydekker, F.R.S., and carried unanimously.

The meeting then proceeded to elect the new members of the Council and the officers for the ensuing year. The usual ballot having been taken, it was announced that Frank E. Beddard, Esq., F.R.S.; William T. Blanford, Esq., L.L.D., F.R. S.; Richard Lydekker, Esq., F.R.S.; Howard Saunders, Esq., and Charles S. Tomes, Esq., F.R.S., had been elected into the Council in the place of the retiring members, and that Sir William H. Flower, K.C.B., F.R.S., had been re-elected President; Charles Drummond, Esq., Treasurer, and Philip Lutley Sclater, Esq., M.A., Ph.D., F.R.S., as Secretary to the Society for the ensuing year.

CURRENT NOTES ON ANTHROPOLOGY.

PRIMITIVE MUSICAL INSTRUMENTS.

THE study of musical instruments begins with two sticks which are rubbed together, or hit one against the other, to make a noise. Such are found among the Australians and the Pueblo Indians. In Louisiana the jawbone of a mule is scratched rapidly with a stick to elicit folk-lore music. The study of this art in early conditions is the theme of an excellent article by Dr. Wallaschek in the Proceedings of the Anthropological Society of Vienna for February. He inserts a number of illustrations from specimens in the Ethnographic Museum of Vienna.

In this connection, I would suggest that the human bones, with incisions crosswise, which are described by Drs. Lumholtz and Hrdlicka in Vol. 10 of The Bulletin of the American Museum of Natural History, and which they are at a loss to explain, were intended for just such primitive musical instruments. Several similar specimens were exhibited in the Mexican department of the Columbian Exposition at Madrid. (See my 'Report,' p. 27.)

PRE-COLUMBIAN LEPROSY IN AMERICA.

THE question of the existence of leprosy in America before Columbus occupied the Berlin Society of Anthropology at several of its meetings last year. The inquiry was started by the investigations of Dr. A. S. Ashmead, of New York City. He had noted on old Peruvian pottery deformations of the face and extremities, resembling those produced by that disease.

The discussion in Berlin was shared by

several members. Some doubted the antiquity of the pottery; others said the representations were from a patient suffering under a local disease called *llaga*. In summing up, Professor Virchow concluded that the pottery was authentic and that the lesions shown were pathological, but that whether from leprosy or some other disease must be left for further investigation.

THE THROWING-STICK IN AMERICA.

AT the last meeting of the French Association for the Advancement of Science Mr. Henri Michel brought sufficient evidence from new finds to show that the throwing-stick was in use in some parts of Peru. He calls attention to the Eskimo throwing-stick described by the traveler Pinart as in use in the Kadiak Archipelago, and also that found in very ancient deposits in France.

It is gratifying to see that, instead of arguing that Peruvians, Eskimo and Cavemen borrowed one from the other, he pointed out that these are examples of independent invention. Evidently, it is not surprising to come across it again in the old village sites of Florida (Cushing), and it is equally needless on this recurrence to found any theory of the affinities of the ancient key-dwellers.

I may add that Mr. Michel is not the first to observe the presence of the *atlatl* in Peru. D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

THE large quantities of compounds of the the rare earths accumulated by the Welsbach Light Company, at Gloucester, New Jersey, under the direction of Mr. Waldron Shapleigh has been alluded to in SCIENCE. Of these earths none are rarer than neodymium and praseodymium, the two elements into which Auer von Welsbach separated what had been previously considered the element didymium. It is pleasing to chronicle that Mr. Shapleigh has put generous quantities of salts of each of these elements in the hands of Professor Harry C. Jones, of Johns Hopkins University, for atomic weight determinations, and the results are published in the last *American Chemical Journal.* More than two kilograms of the ammonium neodymium nitrate, and nearly as much praseodymium, were used as the basis of a careful series of purifications. Twelve determinations were made with each metal, and the atomic weight results are praseodymium = 140.45 and neodymium = 143.6. It is curious that these results are almost the reverse of those found by the discoverer, von Welsbach, 143.6 and 140.8, and almost suggests a question as to whether the discrepancy does not arise from a typographical error in von Welsbach's work. From the fact that the stable oxids are Pr_4O_7 and Nd_2O_3 the higher weight might be anticipated for neodymium, but the placing of these elements in the periodic system is yet a problem.

IN a recent voyage from the Cape of Good Hope to England samples of water were drawn daily from the ocean and analyzed. The results are published by C. J. S. Makin in the *Chemical News*, and compared with the results from the *Challenger* expedition. The average total solids was 36.31 grams per thousand, the quantity being slightly greater in the North Atlantic than in the South, as was found in the *Challenger* samples. In general the results correspond to those of the *Challenger*, but the amount of sodium chlorid was found slightly less (76.9 as against 77.76 parts per hundred of total salts), while the amount of magnesium chlorid (11.4 to 10.88) and calcium sulfate (4.23 to 4.07) was slightly greater. Free ammonia was found 0.19 milligrams per liter; ammonium salts 0.36, and albumenoid ammonia 0.56. J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE RUMFORD MEDAL.

AT the annual meeting of the American Academy of Arts and Sciences held in Boston on May 11th the report of the Rumford Committee which was there presented contained the following important statement and recommendation:

"The committee has also considered at length the question of an award of the Rumford medal. The claims of various investigators and inventors have been considered with great care, and more than one among them appeared to be deserving of such recognition. After prolonged consideration the Rumford Committee has voted at two separate sessions (in accordance with long-established custom) to recommend to the Academy an award of the medal to Professor James E. Keeler, now Director of the Lick Observatory, for his application of the spectroscope to astronomical problems, and especially for his investigations of the proper motions of the nebulæ, and the physical constitution of the rings of the planet Saturn, by the use of that instrument."

The report of the Committee was presented by the Chairman, Professor Cross, who explained at some length the particular nature and merit of the investigations of Professor Keeler for which the award of the Rumford premium was proposed, after which the Academy voted unanimously to adopt the recommendation of the Committee.

The last previous award of the medal was to Mr. T. A. Edison, in 1895. Among others who have recently received it are Professors Pickering, Michelson, Langley and Rowland.

THE COMING MEETING OF THE BRITISH ASSOCIATION IN BRISTOL.

WE take from the *British Medical Journal* the following particulars in regard to the preparations for the meeting of the British Association in Bristol from September 7th to 14th. The latest published list of subscriptions shows that over £3,400 has been promised, that the executive need not fear being short of the prime necessity that makes such a visit a success. The Victoria Rooms are to be fitted up for the reception room, the large hall being used for that purpose and the small hall as a smoking room. The sectional meetings will be held in the school room of the Victoria Chapel, the Fine Arts Academy, the museum lecture room, University College, the Blind Asylum Hall, the Hannah More Hall, the Merchant Venturers' Technical College, and the Park Place Schools. The Drill Hall will be fitted up as a lounging room, a band (the Royal Horse Artillery) provided, and various objects of interest shown; this will be open to all members and associates of the Association free during the afternoon, but in the evening the hall will be open to the public at a charge. The President's address and the lectures will be given in the Colston Hall, as will also be the *soirée* given by the General Committee. The other *soirée* will be given in the buildings and grounds of Clifton College on the invitation of the Bishop of Hereford, the Headmaster, and Mrs. Glazebrook.

In the Zoological Gardens will be a biological exhibition at which many objects of great scientific interest will be shown. Arrangements have been made with the authorities of the Marine Biological Station at Plymouth to show some of their most interesting tanks. A large number of excursions have been arranged to various places of interest—namely, Wells, Glastonbury and the lake villages, Cheddar Cliffs and Caves; Bath, where the corporation will show the magnificent baths recently opened; Bradford-on-Avon, with its Saxon church and Norman bridge; Tortworth, on the invitation of Lord Ducie; possibly Salisbury and Stonehenge; the works at Swindon; the docks at Avonmouth, with a trip down the river to visit the Channel Fleet, if the Admiralty will allow it to come; and many others of interest to geologists, engineers and botanists. A new feature will be introduced in short bicycle rides personally conducted to many of the Roman or British camps around Bristol.

The literature usually distributed is in a forward state, and the handbook will, it is hoped, be the most complete ever given out at a meeting of the Association. The articles are now all in the printer's hands. Eight gentlemen have kindly consented to give garden parties, and Clifton College masters will entertain a large party on September 12th. The invitations,

issued a month or two ago, have been largely responded to, and many foreigners from the Continent are expected, as well as a strong contingent of scientific men from the Dominion. During the week the International Conference on Terrestrial Magnetism and Atmospheric Electricity will hold its meetings in association with Section A (Mathematics and Physical Science). There will be no Section I (Physiology), as the international meeting will be held at Cambridge only a short time previous.

LIQUID HYDROGEN.

ACCORDING to the London *Times* Professor Dewar liquefied hydrogen on May 10th at the Royal Institution and exhibited the liquid to Lord Rayleigh, who was fortunate enough to be on the premises at the time. Hydrogen has been liquefied before—in theory, but Professor Dewar has actually produced the liquefied gas to the amount of half a wine-glassful in five minutes, by a process which would equally have produced a pailful had the requisite supply of pure hydrogen been forthcoming. This is a unique and unprecedented feat. Liquid hydrogen in quantity is not only of enormous scientific interest in itself, but is also of immense importance as placing a new and potent instrument in the hands of investigators who have hitherto found their progress barred by its absence. The boiling point of the liquid may be placed at from thirty to thirty-five degrees of absolute temperature, or, in other words, at about 240 degrees below zero on the Centigrade scale. Some conception of the degree of cold attained may be gathered from the fact that a tube closed at the lower end, when emersed in the liquid, was almost instantaneously filled with solid air. It may be observed, as a matter of scientific interest, that the density of the liquid far exceeds that arrived at by calculation. There is reason to believe that it will be found to be about 0.6, water being unity. This result would agree very closely with the density of hydrogen when occluded by palladium, as established by Professor Dewar 25 years ago. Helium is a rare gas which has hitherto resisted all attempts to effect its liquefaction. It is stored in considerable quantity at the Royal Institution, and was also liquefied on Tuesday by the use of the liquid hydrogen. Its boiling point appears to lie not very far from that of hydrogen itself. Liquid hydrogen will never be as cheap as liquid air, because nature does not supply the gas in equal abundance. But nothing except the cost now stands in the way of producing liquid hydrogen in any quantity that science may require, whether for investigation of its own properties or for the prosecution of various lines of research into the constitution of matter in general.

GENERAL.

THE Council of the Royal Geographical Society have awarded one of the two Royal medals to Dr. Sven Hedin for his work in Central Asia, and the other to Lieutenant E. A. Peary, United States Navy, for his explorations in Northern Greenland. The Council have also made the following awards: The Murchison grant to Mr. H. Warington Smyth for his several journeys in Siam ; the Back grant to Mr. George P. Tate for his survey work in Afghanistan, Beluchistan, especially Makran, Aden and on the Indus ; the Gill memorial to Mr. Edmund J. Garwood for his geographical work in Spitsbergen during two seasons, in company with Sir Martin Conway ; the Cuthbert Peek grant to Mr. Poulett Weatherley for his exploration of the region between Lakes Mweru and Bangweolo. The following foreign geographers and travellers have been elected honorary corresponding members : Don Marcos Jimenes de la Espada, Don Francisco Moreno, Buenos Ayres ; Marquis of Rio Branco, Brazil ; Dr. Thoroddsen, of Iceland ; Professor Ratzel, of Leipzig.

PORTRAITS of Mr. Frederick Fraley and of Professor J. Peter Lesley were presented to the American Philosophical Society, Philadelphia, on May 20th. Mr. Fraley, who has long been President of the Society, and is about to celebrate his 94th birthday, was present. Professor A. H. Smith, of the Central High School, stated that the Society now possessed portraits of all its Presidents, beginning with Franklin. In accepting the portrait of Professor Lesley, Mr. W. A. Ingram dwelt upon his services to geology and geodesy. Professor Lesley has been for many years one of the Vice-Presidents of the Society and had previously filled the offices of Li-

brarian and Secretary. The portraits, both of Mr. Fraley and Professor Lesley, were painted by Mrs. Margaret Lesley Bush Brown, daughter of Professor Lesley.

Mr. C. S. Tomes, F.R.S., has been admitted a Fellow of the Royal College of Surgeons of England.

Lieutenant Robert E. Peary, U. S. N., was the guest of honor at the Geographical Society's annual dinner in Philadelphia on May 18th.

There is a vacancy in the position of Photographer in the United States Naval Observatory at Washington, for which an examination chiefly based upon practical questions in photography and experience in the subject, will be held on June 7th. The salary of this position is $1,200 per annum.

There is also a vacancy in the grade of aid, Department of Biology, United States National Museum, with a salary of $50 per month, for which an examination will be held on June 15th. The subjects of the examination can be obtained by addressing the United States Civil Service Commission, Washington.

Professor E. O. Kendall has presented to the University of Pennsylvania his mathematical library of about one thousand volumes.

The *New York Medical Record* quotes a report that Mrs. Caroline Croft left $100,000 to Drs. Henry K. Oliver and John Collins Warren, of Boston, for the purpose of making investigations to ascertain some method of curing cancer, consumption and other diseases which are now regarded as incurable.

An Audubon Society for the State of Indiana was organized at Indianapolis on April 26th. The meeting was addressed by the Governor of the State, the President of the University of Indiana and others.

The regular spring field meeting of the Indiana Academy of Science was held at Bloomington, April 28th–30th, under the auspices of the Faculty of Sciences of Indiana University. Among the excursions was one to the caves east of Mitchell, the blind fish of which have been described by Professor C. H. Eigenmann.

The House Committee on Interstate and Foreign Commerce has favorably reported the Senate bill appropriating $350,000 for the Commercial Museums' Exposition at Philadelphia.

The Presidents of the Institute of Chemistry, the Society of Chemical Industry, and the Society of Public Analysts, London, have issued invitations to a reception on Tuesday, May 24th.

The Royal Colonial Institute, London, will hold its annual *conversazione* at the Natural History Museum, Cromwell-road, on June 29th.

The Lord Mayor of London gave a banquet on May 4th to the medical profession at the Mansion House. Speeches were made by Sir Samuel Wilkes, President of Royal College of Physicians; Sir William MacCormack, President of the Royal College of Surgeons; Sir William Turner, Lord Lister and others.

The Organizing Committee of the Thirteenth International Medical Congress, held its first meeting on April 23d. The officers of the Committee are: President, Professor Brouardel; Vice-Presidents, Professors Bouchard and Marey; General Secretary, Professor Chauffard; Treasurer, M. Duflocq. The formal opening of the Congress has been provisionally fixed for August 2, 1900.

The Iron and Steel Institute of Great Britain held its spring meeting in the Hall of the Institution of Civil Engineers, London, on May 5th and 6th. The President, Mr. E. P. Martin, occupied the chair, and a number of interesting papers were presented. The autumn meeting of the Institute will be held in Sweden.

We have noted the donation made to Aberdeen, by Miss Cruickshank, of a sum of £15,000, for the formation of a botanic garden. We learn from the *British Medical Journal* that this sum it to be handed over to trustees, who will also form the Board of Management. These trustees are the Principal and the professors of botany and mathematics in the University. The money is to be employed by them in the laying out and maintaining of a botanic garden, with all the necessary appurtenances, including provision for the teaching and study of botany as a pure science, and as applied to arts and industries, and, in their discretion, the provision of a house as a residence for the keeper of the garden. The keeper may, if the trustees

think proper, be the professor of botany in the University. It is especially provided that this bequest is to be in addition to the sum already spent by the University and other bodies on the teaching of botany. The garden is to be known as the Cruickshank Botanical Garden, in memory of the donor's late brother, Dr. Alexander Cruickshank, and it is to be held by the trustees in all time for the use, enjoyment and behoof of the University of Aberdeen and of the general public, without any preferable right on either, except as it may be thought right by the trustees to set apart class-rooms and laboratories for the use of either body. Professor Trail, the professor of botany, in his opening address to his class at the beginning of the summer session, on April 25th, alluded to this gift, and to the great advantage which it would be to the botanical department at the University. He also touched on the changes which the last few years had worked in this department, and on the great facilities which were now offered to botanical students, especially since the opening of the handsome new laboratories and class-rooms last year.

A LETTER addressed to the London *Times* by 'A Kew Student' protests against opening the gardens to the public in the mornings, as follows: As holder of a student's ticket which will be rendered practically useless by the change, may I be allowed to explain how the proposed opening of the gardens at 10 a. m. will affect students at Kew? The difficulty does not lie in the large or small number of visitors, but in a rule—namely, that students must abstain from handling plants after the admission of the public. I am informed that this regulation is so far necessary by way of example that it is observed by the authorities themselves. The public recognize a working gardener, but if one stranger were seen to interfere with plants others would naturally see no harm in doing the same. Where the convenience of the public is concerned, individual protests appear selfish and ridiculous, but I am informed that there are 800 students upon the books, and surely their interests deserve consideration, inasmuch as Kew-gardens are intended to be used for scientific purposes. As an individual I should have been satisfied and very grateful if students had been permitted to retain certain mornings of the week, and I shall be glad if you will allow me to point out that the recent decision has caused disappointment and vexation to at least one worker. My ticket carries the privilege of gathering certain specimens for botanical research; it will be difficult for students, who like myself live in London, to use the gardens before 10 a. m., and it is out of the question that I, or any other student, should collect plants out of doors or work in hothouses during public hours.

AT a meeting of the Zoological Society of London on April 19th a communication was read from Dr. Bashford Dean, describing further evidence of the existence of possible paired fins in the problematical Devonian organism *Palæospondylus*. He maintained his former views, as opposed to those of Dr. R. H. Traquair expressed in a former communication to the Society. Mr. Smith Woodward, in communicating this paper, remarked that he was inclined to agree with Dr. Traquair's interpretations of the markings on the stone round the skeletons of *Palæospondylus* as entirely due to inorganic agencies. In support of this view he exhibited the specimen from Dr. Traquair's collection noticed by Dr. Dean.

UNIVERSITY AND EDUCATIONAL NEWS.

THE new buildings of the University of Virginia will be dedicated in June, the exercises beginning on the 12th. It is expected that three Presidents of the United States, Mr. McKinley, Mr. Cleveland and Mr. Harrison will take part in the ceremonies.

THE building for the museums of the University of Pennsylvania is now nearing completion, and plans are being drawn for a building for the departments of physiology, pathology and pharmacology.

A BUILDING for the College of Agriculture of Ohio State University has been completed during the present year at a cost of $70,000.

CONGREGATION, at Oxford, passed, on May 4th, a decree which will require the ratification

of Convocation, authorizing the expenditure of $7,500 in removing and reconstructing the iron laboratory at the University Museum, at present occupied by the Linacre professor of comparative anatomy, and in erecting, on or near to the site of that laboratory, a new laboratory and lecture-room for the joint use of the Sherardian professor of botany and the Linacre professor of comparative anatomy.

BY the will of the late Dr. Elizabeth H. Bates, of Port Chester, N. Y., the University of Michigan will receive $125,000, the income from which is to be used in establishing a chair for the diseases of women and children, to be known as the Bates professorship.

THE will of the late Mrs. Annie S. Paton, of New York, leaves $100,000 to Princeton University, subject to an interest for life of her two sons. The bequest is to found a fund for an endowment for Paton lectureships in ancient and modern literature.

THE *Troy Times*, in its supplement of April 2d, devotes its whole space of 24 large pages to a description of Cornell University by ex-Governor Cornell, President Schurman and members of the Faculty, with many illustrations of the campus, the adjacent country and grounds and buildings, and with excellent portraits of prominent founders, heads of leading departments and lecturers. The issue constitutes the best and most complete popular account of a great educational institution that, perhaps, has ever come from the press of even our leading newspapers. It is a most admirable tribute to higher learning, as well as to the university which is its subject.

THERE are this year four hundred and thirty-eight candidates for degrees at Cornell University, of which twelve are for the A.M. and twenty-six for the Ph.D. degree.

THE American fellowship of the Association of Collegiate Alumnæ has been awarded to Miss Caroline Ellen Furness, a graduate of Vassar College and now assistant in the Vassar College observatory. Miss Furness has also won the scholarship in astronomy and mathematics offered by Barnard College. She will study at Columbia University.

THE following fellowships have been awarded at Bryn Mawr College: *Mathematics*—Louise D. Cummings, of Canada, A.B., University of Toronto; Fellow, University of Pennsylvania, 1896–97, now graduate student University of Chicago. *Chemistry*—Margaret B. MacDonald, of Virginia; Graduate in Science, Mt. Holyoke, where she was for two years assistant in the laboratory before coming to Bryn Mawr, has been studying at Bryn Mawr during this year as graduate scholar. *Biology*—Annah Putnam Hazen, of Vermont, B.L., Smith College, 1895; M.S., Dartmouth College, 1897; graduate student, Bryn Mawr College, this year and graduate scholar.

PROFESSOR EDWIN BRANT FROST, of Dartmouth College, has been elected professor of astrophysics at Yerkes Observatory. The *Chicago University Record* states that after graduating from Dartmouth in 1886 Professor Frost took Professor Young's course in practical astronomy at Princeton, and returned to Dartmouth as instructor in physics and astronomy. In 1890 he went to Germany and spent one semester at Strassburg, where he intended to continue his studies. But the opportunity of becoming voluntary assistant at the Imperial Astrophysical Observatory in Potsdam, which is but rarely accorded, took him to that celebrated institution, where he assisted Professors Vogel and Scheiner in their important spectroscopic researches on the motion of stars in the line of sight. A year later he was appointed assistant on the regular staff, and undertook his well-known investigations on the thermal radiation of sun-spots and the solar surface. The results of this work have cast grave doubts on the validity of the long accepted idea that sun-spots are cavities in the photosphere. In 1892 Mr. Frost was elected assistant professor of astronomy in Dartmouth College and Director of the Shattuck Observatory. Three years later he was advanced to a full professorship. His best known work since his return from Germany is his translation and revision of Scheiner's 'Astronomical Spectroscopy,' which everywhere takes precedence over the original as the standard treatise on the subject. At the Yerkes Observatory Professor Frost will devote special attention to a photographic study of stellar spectra with the large telescope.

PROFESSOR E. F. NICHOLS, of Colgate University, has accepted a call to the chair of physics at Dartmouth College.

DR. C. M. BAKEWELL, of the University of California, has been appointed associate professor of philosophy at Bryn Mawr College.

THE Frank Small studentship in botany of Gonville and Caius College, Cambridge, will be vacant in June. It may be held for two or three years, and is of the annual value of £100.

THE Aberdeen Universities Court has appointed Mr. John Clarke, M.A., Aberdeen, to be lecturer in education for the term of three years, in succession to Dr. Joseph Ogilvie, whose term of office has expired.

DISCUSSION AND CORRESPONDENCE.

SPIRITUALISM AS A SURVIVAL.

TO THE EDITOR OF SCIENCE: The discussion in SCIENCE in regard to the occult phenomena supposed to be manifested by Mrs. Piper induces me to recall a controversy I had with a distinguished psychologist who expressed the belief that in Mrs. Piper he had, at last, encountered evidences of a supernatural character. In a discussion with a very eminent Englishman, a spiritualist, I found that he placed implicit faith in mediums who had been repeatedly exposed as most arrant humbugs. No intelligent seeker after evidences of supernaturalism would, for a moment, accept the manifestations of these frauds, and yet, with the blandness of an insane person, this eminent spiritualist received, without a reservation, the messages of these humbugs. In the Proceedings of the Society for Psychical Research two eminent psychologists recount the remarkable performances of a medium in Sicily, which they fully accepted as genuine, yet my distinguished psychologist above mentioned, with his keen method of penetrating frauds of all kinds, exposed this apparent wonder. Now he in turn encounters Mrs. Piper and, his limit of penetration having been reached, he falls into line just as promptly as the rest. Here you have, then, a number of men with varying degrees of penetrating powers. One set all agape with speculative wonder, as Huxley said of Bastian, accepting stuff as genuine which many alert newspaper reporters had shown to be spurious; another set, endowed with a modicum of common sense, repudiating the peripatetic mediums yet snared by more skillful frauds; still higher are others who are not deceived by these, but are in turn bamboozled by more deftly played tricks; and finally the highest intellects who, in an encounter with some exceedingly adroit female medium, are puzzled by the manifestations and, not having that judicious calm which might frankly wait for more light, plunge into the regions of the occult for an explanation as readily as did their more ignorant confrères under the capers of the charlatans. I think a fair explanation of this attitude of the human mind, which always excites more wonder in a rational being than do the séances of cunning mediums, is that we have clearly before us the evidences of survival. From a time when all believed in omens, portents, dreams, warnings, etc., what wonder that a sufficient number of molecules have been transmitted whose potency overrides common sense. In no other way can we explain why in the latter years of the nineteenth century there are in our midst men, otherwise intelligent, who fully believe in astrology. It is as utterly impossible to convince people thus afflicted as it would be to argue with inmates of an insane asylum. We may regard with interest, akin with pity perhaps, those who waste their phosphorus in trying to convince the world that they are right. We are compelled to explain their attitude, not by significantly striking our head with the index finger as we contemplate them, but by insisting that they present most interesting examples of survival, and, if they did but realize it, how interesting they would be to themselves!

The conception of a flat world was at one time universal; to the masses, however, the demonstration that it was round or square or pyramidal induced no special mental disturbance—no more, indeed, than when it was shown that the air they breathed was composed of certain gases, had a certain weight, etc. The belief in dreams, omens, signs, etc., was an active one; it was invoked at all times; the mind, for centuries, was super-saturated with it, and hence its survival among children, today, among the masses and, rarer still, among

the highly gifted. The question of flatness of the world had, with the masses, hardly an existence; no molecules of the brain were exercised by it; the disturbance occurred only among the learned. Is it for this reason that we find so few survivals, to-day, of those who believe the world is flat?

EDWARD S. MORSE.

SALEM, May 17, '98.

'THE NEW PSYCHOLOGY.'

TO THE EDITOR OF SCIENCE: Professor Stanley's interesting letter is timely and valuable; it calls attention to a fundamental difference in standpoint between two schools of psychologists. This difference has been indicated by Professor Cattell in the following statement: "As a science advances beyond the stage of crude observation it tends to become either quantitative or genetic." The former tendency has produced experimental psychology; the latter genetic psychology.

The standpoint of experimental psychology—as far as I can understand the principles of its representatives—can be briefly stated as follows: *Given a group of phenomena, called 'phenomena of consciousness;' required a determination of the laws according to which these phenomena are connected.* This is a problem similar to that of astronomy, physics, meteorology, geology, biology, political economy—in fact, of all the sciences. In the early stages of a science the only solutions possible are those of 'yes' and 'no;' *e. g.*, does the memory of an object improve with interest and the lapse of time? to which the answers are: 'yes' for the former and 'no' for the latter. The introduction of methods of measurement—which is the special achievement of the new psychology—renders quite a different solution possible. The question just stated becomes: *how* does the memory of an object depend on interest and the lapse of time? The answer is as follows: Denote all the possible factors that may influence the memory by a, b, $c, \ldots, i, \ldots, t, \ldots, x$. *Keeping all the circumstances except i constant*, determine the relation of dependence of the memory on i, which is simply a roundabout method of saying: Let $a, b, c, \ldots =$ const. and find $M=f(i)$, where M is the accuracy or uncertainty or some other property of memory in the particular case. The method of solution, familiar to all experimentalists (see p. 77 of 'New Psychology'), consists in varying i quantitatively and measuring the resulting variations in M; the results when properly treated give a formula connecting the two; this is known as a law of memory. The fundamental necessity for such work is the method of measuring the quantities considered.

Professor Stanley remarks: "We must first devise some method of measuring interest;" it follows that we cannot determine this law of memory because such a method has not been found. This is quite true; the proper reply is to devise such a method—an undertaking not difficult to any one trained in psychological experiments. We can, however, measure time, and have in a number of cases (Wolfe, Ebbinghaus) determined the laws of various kinds of memory as depending on time or $M=f(t)$. The ideal solution—which Professor Stanley seems to expect at the start—is $M=F(a, b, c, \ldots, i, \ldots, t, \ldots, x)$ or the determination of the complete law of memory as depending on every possible circumstance. Perhaps some day psychology will make some approximation to such a solution; at present it must remain content with determining single laws.

Professor Stanley is quite wrong in assuming that this method is peculiarly a physical method. It belongs no more to physics than to chemistry (see the late works on mathematical chemistry), to political economy (Carnot, Jevons, Fisher), to biology (Pearson). It is merely a fundamental method of thought which is applicable wherever measurements can be made. In fact, we can reply to Professor Stanley that his science of genetic psychology must inevitably come to the use of this very method. Every single factor influencing the life of an individual or a community acts to a degree depending on its intensity according to some law; supposing all other factors to remain constant, this law is given by its action under those circumstances. By carefully measuring the action of each factor and its result on each property of mental life, the genetic psychologist could state the result as a series of laws of mental development. To be sure, this is rather a difficult task to propose,

but we may confidently expect the beginnings of such a genetic psychology in the future. At any rate, in this field, as in most other fields, progress and profit are increased by greater exactness and care, by more accurate and convenient apparatus and by shorter and more definite methods. These elements are the ones which experimental psychology is trying to introduce into the exploration of mental life. The fact that these methods are somewhat new in psychological work gives us the right to call a system of them a 'new psychology.'

Professor Stanley's claim that biology is the main standpoint of psychology is quite justified —if 'psychology' means the science of mental development. It must be remembered, however, that there is a fundamental difference in aim and method which marks off experimental psychology from the other mental sciences. Its object is to determine the fundamental laws of mental activity in the adult human being under ordinary circumstances. The change of the problem to child-study, to the development of the individual or of the race, or to abnormal circumstances, produces closely related sciences. All these sciences are inter-dependent. In fact, all these sciences—as Professor Stanley implies —are needed for a concrete, practical understanding of mental life; nevertheless convenience and clearness sometimes require that attention should be concentrated on one of them at a time.

E. W. SCRIPTURE.

NEW HAVEN, CONN., May 20, 1898.

FOSSIL FULGUR PERVERSUM AT AVALON, N. J.

ON page 682 of SCIENCE the quotation from Captain Swain, of the Avalon Life Saving Station, N. J., with reference to the casting ashore of *Fulgur perversum* is slightly inaccurate. I now quote from his letter the passage I read at the Academy that "the conchs in question come ashore only during a strong northwest (not northeast) wind that happens immediately after a northeast or a southeast gale, a northwest wind is the only kind that will bring heavy substances ashore, it seems to make the surface current offshore, and this creates an under current on-shore." I have no doubt that *Fulgur perversum* at the locality is raked out of a fossil bed a short distance offshore, and that this off-shore wind after the on-shore gales favors the tides and currents in doing so.

LEWIS WOOLMAN.

THE DEFINITION OF SPECIES.

I HAVE stated in this JOURNAL (N. S., VI, 329) that I believe the quantitative study of variation to be the most pressing problem of biological science. I have consequently read with great interest the papers by Professor Davenport and Mr. Blankinship, on 'A Precise Criterion of Species' (page 685 above). It seems evident that for the definition of species we should not depend on a 'type specimen,' the one first found, in the best state of preservation or the like, but should collate a considerable number of specimens taken at random, and when the traits can be measured give the averages and the mean deviations. Then, as Mr. Davenport explains, we have double-humped curves showing a tendency for the type to split up, and these are of the greatest possible interest to the student of the causes of the evolution of species.

When, however, Mr. Davenport proposes to use a given relation between the height of the smaller hump and the depression between the humps*—namely 100 : 50—as a precise criterion

* This relation depends not only on the distance between the apices, but also on the relative number of specimens of the two types, which, of course, has nothing to do with the difference between the types. There are other cases in Mr. Davenport's paper where the statements seem scarcely to take account of the complexity of the problems. It is meaningless to say that 'in some cases fifty per cent. or even more of the individuals will occur at the mode' and that in this case the curve is steep. The number of individuals at the mode depends on the unit of measurement selected, and the steepness of the curve is arbitrary. The 'half range,' defined as three times the 'standard deviation' (error of mean square), is a theoretically impossible point, and could only be determined approximately from thousands of specimens. Thus in Mr. Davenport's Fig. 9 the 'half range' of the right-hand curve is tripled by a single specimen. In all these cases Mr. Davenport neglects the probable errors which when reckoned show that his distinctions between species and varieties have no validity whatever. The data of Fig. 9 can be expressed by a curve with a single apex.

of species, I cannot follow him at all. Size and weight—the traits that can be measured—are especially dependent on the environment and variable within the same species. Varieties of dogs may not intergrade at all in size and weight, or in the relative dimensions of the skeleton, but this does not lead us to call them separate species. The cephalic index is one of the most important differentials in man, but the fact that it may not intergrade does not turn races into species. The conditions are far more complex than Mr. Davenport assumes them to be. A certain quantitative amount of intergrading may mean entirely different things under different circumstances, and the various differentials of a species may intergrade to very different degrees. It does not follow that the chief differential is that quantitative characteristic intergrading the least. It may be the teeth or the reproductive system or whatever serves most conveniently as a basis of classification.

My excuse for writing on the definition of species is that I hold it to be a psychological problem. In pre-evolutionary days the naturalist undertook to discover species that had been created ; now it is he who creates the species.* The problem is analogous to deciding how many colors there are in the spectrum; it may be held that there are three, or four, or seven, or two-hundred. There are, indeed, various criteria that may be used in the separation of species, of which the most important seem to be : (1) the phylogenetic history when known ; (2) hereditary stability and variability ; (3) the tendency to cross and the fertility of crosses, and (4) intergradation. The last named factor is not only quantitative, as in the cases given by Mr. Davenport, but also qualitative, and here the naturalist must try to use as his unit what the psychologist calls the 'just observable difference.' The degree of distinctness that shall constitute a species must, like the meaning of every word, depend on the best usage. As the usage of the best writers is compiled and given currency by dictionaries, so the usage of naturalists is compiled and given currency in a work such as *Das Thierreich.* The criterion given prominence by Messrs. Davenport and Blankinship should be carefully studied, but it is only one of many factors, and these must be distinguished and adjusted by the powers of observation and judgment of the naturalist. The definition of species is, as I have said, a psychological problem.

*I fear that I am here sailing under Dr. Merriam's heavy guns. He has written : "The function of the naturalist is neither to create nor destroy species, but to recognize, describe and learn about those which nature has established." (SCIENCE, N. S., V., 124.) Innumerable coyotes, differing more or less, live or have lived, and Dr. Merriam, not nature, has established eleven species. Some other naturalist has created the coyotes.

J. MCKEEN CATTELL.

SCIENTIFIC LITERATURE.

Contribution towards a Monograph of the Laboulbeniaceæ. By ROLAND THAXTER. Memoirs of the American Academy of Arts and Science. 1896. Vol. XII., No. 3. Pp. 189–429. 26 plates.

This is the second important memoir by Dr. Thaxter on Entomogenous fungi, the first being a monograph of the Entomophthoreæ. The very large number of these plants which are being brought to light by the keen observation and untiring industry of the author of this memoir is a surprise to any one acquainted with the literature of the subject.

As Dr. Thaxter states in the introduction, his study of Entomogenous fungi was begun with the intention of embodying in a single monograph all species truly parasitic on insects. But the number of species of the Entomoythoreæ were sufficient for a monograph of considerable proportions, and now the hitherto insignificant family of Laboulbeniaceæ has, under his indfatigable researches, grown to an order of formidable proportions, while several other groups of insect fungi remain yet to be investigated.

While a few of the members of the genus *Laboulbenia* have been known for nearly one-half a century, our knowledge of the development, sexuality and formation of the spores has remained very imperfect. This, together with the difficulty of defining the position of the family in relation to other thallophytes, has probably had much to do with the almost universal absence of treatment of these forms from text-books of fungi.

The plants are remarkably peculiar in form and remarkably simple in structure, and probably represent degraded remnants of a more complex ancestry. The environment which they meet because of the peculiar habitat must have had a powerful influence in reducing them to their present rather stereotyped morphology. For while it has now been shown that there are considerable variations in species, and a goodly number of both species and genera are represented, one is struck by the constantly recurring facies running through many of the different genera.

The members of the family are attached to the legs or bodies of insects, usually those inhabiting damp or wet localities. An individual consists of a simple stalk for attachment, which bears a simple elongate perithecium as a lateral appendage, or is terminated by the same, while the antheridia may terminate the plant, or occur as a simple or tufted lateral growth. By studies of the development of a large number of species, and by the examination of a large series of forms, the limits of specific variation have been quite well determined, so that a fairly good basis has been established for the recognition of species and genera, and the systematic arrangement of the known forms can be presented with a good deal of confidence.

The discovery by Karsten, as early as 1869, of a trichogyne on the perethicium, and the fusion with it of bodies resembling the sperm cells of the Rhodophyceæ, indicating sexuality in these plants, has been fully confirmed by Dr. Thaxter's studies, and we need now only the knowledge of the actual nuclear fusions in the different steps of fertilization to show how the ascus originates as a result. The female organ shows a striking resemblance to the trichophoric apparatus in certain of these algæ, as suggested first by Karsten. These investigations serve to confirm this view, and the conclusion is drawn that this family of ascomycetes has originated from the Florideæ, and may possibly have been the point of origin of the ascomycetous fungi, Twenty-eight genera and one hundred and fifty-two species are described and illustrated; the larger majority of these are named by the author.

GEO. F. ATKINSON.

A Report on the Work and Expenditures of the Agricultural Experiment Stations for the Year Ended June 30, 1897. By A. C. TRUE. U. S. Department of Agriculture, Office of Experiment Stations, Bulletin 50. 1898. Pp. 97.

This valuable document should be perused by every friend of science in America. Dr. True, the Director of the Office of Experiment Stations, has not only followed the work of the stations from his office in Washington for many years, but has himself visited and critically investigated every one of them. Unlike many critics of station work, he has been slow in arriving at conclusions; erring, if at all, on the side of extreme caution rather than of haste. His natural bias of mind seems to be conservative, and added to this is his evident sense of the responsibility of his position; so that we may be sure his criticisms and suggestions for reform are only those which he has felt forced to make in the face of overwhelming evidence.

Yet we read these words (pp. 6–7): "In one respect the past year has been a period of unusual discouragement to those who have the best interests of the experiment stations at heart. From changes in the constitution of the governing boards, due to legislative action, changes in the Governors having power of appointment or removal of members of these boards, and other causes, the Directors of the stations in ten States and Territories have been changed since the last [annual] report was prepared. In several cases the Directors removed had had long and successful experience in the management of the stations and had made their work increasingly useful. In these and other cases the removal of the Director was accompanied by a further reorganization of the station staff. * * * The numerous changes in the station staffs recently made are calculated to shake faith in the wisdom of committing the stations so fully to the control of the local boards."

Taking the stations separately, we find:

Idaho.—"The station has fallen behind in its publications; its finances have been in an unsatisfactory condition, and its operations have been very largely of a superficial character."

Kansas.—"Out of fourteen persons constitut-

ing the station staff, whose names were published in our official organization list, February, 1897, six are now on the staff, three of the officers retained being assistants. Our examination of the expenditures, publications and work of the station has not revealed any good and sufficient reasons for this radical reorganization."

North Carolina.—"The station has been weakened by the loss [*i. e.*, dismissal] of successful and experienced officers and by the uncertainties attending a change of management and a somewhat dubious financial outlook."

North Dakota.—"The recent dismissal of the experienced veterinarian and the appointment of an untried man in his place has awakened fears that the influences which hitherto have hindered the progress of the station are still at work."

Oregon.—"The affairs of the Oregon Station during the past year have not been in a satisfactory condition. * * * At the close of the fiscal year the President and Director was removed after one year's service. The Horticulturist and Assistant Botanist were also removed."

West Virginia.—"After some nine years of faithful service, during which period he had managed the station successfully under unusual difficulties * * * the Director was dismissed by the board at its first meeting, though no charges affecting his personal or professional standing were preferred."

And so forth. Of course, it must not be imagined that all the stations are subject to these evils, nor would Dr. True admit for a moment that the stations as a whole are a failure. On the contrary, the splendid work done by many of these institutions, such as those of Wisconsin, Ohio, New Jersey, Minnesota, Massachusetts, Cornell University, etc., cannot be too highly praised or too warmly supported. These wisely-governed stations have demonstrated beyond question that the money spent under the Hatch Act may be made to yield handsome profits to the nation; that the expenditure of national funds for scientific research is one of the best means of preserving and increasing the wealth and reputation of the United States. We are indebted for very much to the laboratories of Europe; but the time has come when one can rarely open a recent European work on any branch of agricultural science without finding numerous and flattering references to the U. S. Department of Agriculture and Experiment Stations. If this is so, what are the people of the United States about that they permit such golden opportunities in many cases to be lost—muddled away by men of whom it is charitable to suggest that they are merely incompetent? What are the scientific men of this country thinking of, that they witness unmoved the desecration of the very temples of science? I do not suggest or know of anything worse than is plainly to be read in this report now before us, the work of a cautious scientific man, who has had every opportunity for ascertaining the actual facts. It is not necessary to go behind Dr. True's deliberate statement to find grounds for an energetic movement in support of genuine scientific work and workers in the experiment stations.

To merely contemplate the virtual loss of so many thousand dollars through bad management here and there would give quite an erroneous impression. We can afford to lose the whole Hatch fund every year, if it must be, without serious detriment to the nation; *but we cannot afford to lose the fruits of scientific research, which are worth an incalculable sum.* If one station has produced good results, so can all, under proper control. There is probably not a station in which much good work has not been in progress at one time or another; but in many instances the natural fructification of a research has been prevented, and in consequence past efforts rendered unavailing.

The duty of scientific men in this matter is clear. They should, in the first place, seek to become familiar with the good work of the stations, so that they can appreciate what is being done, and realize how much more might be done. They should then make it their business to protest vigorously against every effort to interfere with competent workers, or interrupt the continuity of their work; while at the same time educating the people to a sense of the possibilities inherent in experimental work. If every man of science in this country would thus

work in the interests of his muse, instead of merely for his own selfish ends, the public would not be slow to appreciate scientific work more nearly in accordance with its merits.

T. D. A. COCKERELL.

Il Codice Atlantico di Leonardo da Vinci nella biblioteca ambrosiana di Milano. Reprodotto e pubblicato dalla Regia Accademia dei Lincei sotto gli auspice e col sussido del Re e del Governo. Milano. ULRICO HOEPLI, Editore Librajo della Real Casa e della R. Accademia dei Lincei. New York, G. E. Stechert. 1894–8. 35 parts; 800 pages; 1750 drawings and illustrations; folio. $240.

This magnificent reproduction of the extraordinary works of one of the most wonderful men of genius known to history is a work for which the world has long waited. It is issued in parts to subscribers, and none are furnished to the trade or furnished as complimentary copies. Each of its thirty-five parts contains 40 heliotype plates, reproducing the drawings and sketches of the great author, with double transcription of the text, and with notes. It is printed upon hand-made paper, 38 cm. (15 in.) by 50 cm. (20 in.) in dimensions; and but 280 copies, it is stated, will be issued. The first 20 copies are supplied to the earliest subscribers, in order of date, at a discount of 20 per cent. Inspection is permitted of the first part before subscribing.

The work has been performed under the direction of the Italian Ministry of Public Instruction, and with direct supervision of the Royal Academy, and the transcription was made by Dr. John Piumati—already distinguished both for his learning and for his success in earlier and somewhat similar work—assisted by Lucas Beltrami, well known in connection with his work on the Vincian Codex of the Trivulzian Library. The work is intended to give as complete a reproduction as the existing remains permit of the collection of manuscripts of Leonardo, now almost four centuries old, which, since the death of Menzi, a half-century after their completion, have been dispersed.

Pompeo Leoni gathered a large proportion of them together, somewhat later (1587), and produced the 'Codex Atlanticus' of that time. Cardinal Frederic Borromeo ordered its transcription in 1626, and his Ambrosian Library became its possessor in 1637, meantime an offer of a thousand doubloons from Charles I. of England having been refused. During the last century Anthony David made a study of its collections in mechanics, and Balthasar Oltroccio, Governor of Ambrosian Library, made it the basis of a Life of Leonardo, later published by Amoretti. The Codex itself was captured by the French in 1796, and taken to Paris for the National Library, where Venturi found it and made it the source of his writings upon physics and mathematics, largely.

Libri, Omodeo, Angellucci and others studied it in its old home, but the publication of the whole collection has only now been undertaken. The commencement of the enterprise here illustrated was actually made with the issue of the 'Saggio' at the time of the inauguration of the monument to Leonardo, at Milan, in 1872; its twenty-four plates giving a foretaste of what was coming, so interesting and absorbing to collectors and admirers of the great soldier, poet, engineer, artist, and man of science, as to compel immediate assurance of the ultimate completion of the work.

This splendid reproduction will throw new light upon the character and achievements of the man who has been mainly portrayed by his biographers as a sort of Admirable Crichton with a genius primarily artistic, and who have obtained their ideas from such biographies, rather than from a source giving a true account of his life and his work in all its various fields. Even a cyclopedia like Johnson's, generally regarded as having a scientific rather than a literary or artistic character, gives prominence to his accomplishments as artist, says little of his achievements as soldier, his talents as engineer, or his learning in science and in literature. His 'Last Supper' is given deserved attention; a catalogue of his paintings is presented, and a good bibliographical list is submitted; but its author says: "It is impossible, in the space at command, to give an account of Leonardo's scientific labors;" and none is given, and but little is suggested, to indicate to the reader the fact that he was a great military engineer, a

talented inventor, a skilled mechanic, and perhaps the most learned scientific man of his age and nation.

The fact is that it was Leonardo who re-imported, more than any other scientific man of his time, the sciences of the Saracens, after their migration from ancient Greece with the disciples of Aristotle and the Ptolemies, and their long residence in Egypt, their incorporation with the older learning of the Orient and of the Arabs, and their purification and systematization by union with the mathematical, and especially the astronomical, sciences of those builders of its most solid foundations. It was Leonardo who made applied science systematic, who studied botany as a biologist, interpreted geology, laid the scientific foundation of professional engineering construction, and who, in his studies of the true theories of mechanics, and of their utilization in the arts of war and of peace, made of himself that type of the modern man of science now most characteristic of our own time, the man of science employing a combination of pure and applied science in the promotion of all the arts of the civilization of his time. These facts are not always even suspected by the reader of existing biographies, but a study of this unique collection of heliotyped plates, *fac similes* of his drawings, will bring the true character and the real life and habits of the man into view, and will throw into high relief the most important characteristics of his genius.

This graphical autobiography is the story of the life and work and inmost thought of the man, without intermediary. It shows him constantly engaged in devising new machinery, usually of war, with new plans for the application of scientific learning, of reduction to practice in the art of war, principally, of the then novel discoveries of science; utilizing the returning current of physical, chemical and mechanical sciences; then recrossing the Mediterranean, never to be again lost to Europe or the world.

These singularly interesting drawings are reproduced with all the fidelity coming of the use of heliographic processes; and one of the interesting and curious evidences of the fact that they are made perfect *fac similes,* without reference to their character, is seen in the inscriptions, autographic incriptions by Leonardo, which must be read by the use of a mirror. The Italian is perfectly good and intelligible; but, until it is noted that the plates are thus reversed, it is somewhat of a puzzle to the student of Leonardo's sketches. The whole constitutes, that form of condensation of the invention and the arts for his time, which is similarly illustrated by Hero, the Greek author, many centuries earlier, in his 'Pneumatica,' and by Branca, by Leupold and by others since, in other places and in more modern times. The work will have value from many points of view and will find its place in every library of importance. It should, and undoubtedly will, become familiar soon to all collectors, to all men of science, and to the professional posterity of Leonardo among members of the engineering professions. Its publication cannot fail to add enormously to the fame of an already famous man who has rightfully been regarded, even in the absence of this testimony, as perhaps the most eminent example of the 'universal genius,' in science, literature and art, and the arts as well, yet given a place in history.

Leonardo, the biologist, anatomist, botanist, hydraulician, geometrician, algebraist, mechanician, optician, the inventor of the marble-sawing machine, a rope-making apparatus, of innumerable varieties of ballistic machines and ordnance, the seer of coming steam-engines and of steam-navigation and transportation, of steam-guns and breech-loading arms with the 'modern' screw-breech-block, of canals and other engineering works, the maker of uncounted plans, designs and inventions; in fact, this Leonardo is revealed, not in biographies, but in his manuscript, of which even this great Codex constitutes only a fraction. Such widely distributed interests and such variety of talent could not be exhibited to-day, even by a man like Leonardo, of rare genius, unequaled talent, indefatiguable industry and unlimited ambition; and even in the sixteenth century this universality of genius was without rival among men of science, and Leonardo's was the noblest mind of his time.

R. H. Thurston.

SCIENCE

FRIDAY, JUNE 3, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

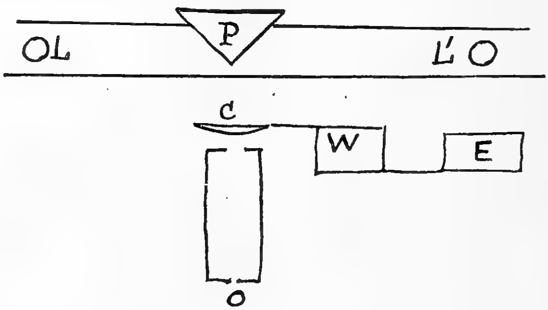
ON A FLICKER PHOTOMETER.

IN the September number of the *American Journal of Science* for 1893 I described a photometric method founded on flickers which I had proved to be independent of color, and stated that there did not seem to be any reason why it should not be applied to ordinary photometric work. In January, 1896, Professor F. P. Whitman published, in the *Physical Review*, an account of a photometer with a revolving disc of cardboard, in which this flicker method was utilized with more or less success. Afterwards I constructed and experimented with five different forms of flicker photometers, and in November, 1896, read a paper on the subject before the National Academy of Sciences.

I propose here to give a short account of one of these forms, and to mention a few experiments that were made with it by myself and others.

The two sides of the white, upright, 90° prism, P, are illuminated with the lights to be compared, coming from the incandescent lamps L and L′, and the flicker is brought about by the rapid motion of the cylindrical lens, or biprism of small angle, C. This is caused to oscillate horizontally by a train of toothed wheels, W, which can either be turned by hand, or better by a small electromotor, E, the speed of which is regulated by a friction break. When the apparatus is in action the two illuminated sides

of the prism, P, are presented rapidly in succession to the eye placed at the aperture, O. The incandescent lamps, L, L′, move over graduated bars or 'ways,' the total length of which is 3.3 meters. A long light wooden rod with a square cross-section is employed to move one of the lamps, and to carry the filet of paper on which the readings are registered, obviating the necessity of removing the eye from O.



It is important that the edge of the prism where its faces meet should be *sharp*, and a satisfactory prism of this kind I have made from plaster of Paris cast in a peculiar mould, but unglazed paper stretched over a well-made wooden prism answers tolerably well, when prepared with a preliminary vertical cut extending not quite half way through the paper. In all the determinations given below, this arrangement was used, although it is certain that a prism with an *invisible* edge would have furnished still better results. The electromotor was usually employed; always when persons other than myself used the apparatus.

In order to show the action of the photometer with white light some experiments by myself in company with other persons are given below. The relative illuminating power of two 16-candle power incandescent lamps was determined by Dr. Tufts and myself on the same day, the results in each case being the mean of 15 readings.

Dr. Tufts	O. N. R.
90.79	90.94
91.49	
91.14	

The difference between Dr. Tuft's mean and my result being $\frac{2}{10}$ of a per cent.

Three weeks later I made experiments, still using white light, with ladies, who saw the photometer for the first time. The figures obtained were:

Miss L.	Miss H.	O. N. R.
92.47	91.31	91.33

To test the action of the photometer with saturated colored light, the amount of light transmitted by a plate of red glass was directly determined, the result being that out of 100 rays of white light it transmitted 14.6. In this case the flicker was, of course, between almost spectral red and white light. A similar determination was made with a plate of green grass; it transmitted 8.4 rays. Here the flicker was between almost spectral green light and white.

These two plates of glass were then placed on opposite sides of the prism and the ratio of the amounts of light transmitted by them determined. In this case the flicker

was between spectral red and green. In the calculation of the results the amount of red light transmitted was taken as 14.6, and the amounts of green light calculated from the ratios obtained; these were as follows:

8.7
8.9
8.7
8.9
9.4
8.6
8.3
8.78

The mean of all the results was 8.78, instead of 8.4 per cent, as directly determined.

These measurements were made by myself, but I thought it would be interesting to see how nearly the same result would be obtained by a person wholly unused to the photometer, and in general to photometric work. Miss L., after the nature of a flicker had been explained to her, at once obtained 9.07, which differs by $\frac{3}{10}$ of a per cent. from the mean of my more elaborate work.

Results of equal or greater accuracy were obtained by myself and others using blue and red light, or green and blue light, all of them being intense or saturated. No trouble was found in causing the disappearance of the flicker when the speed of the motor was properly regulated, nor were the eyes more fatigued than in making ordinary optical observations; of course, if the illumination is feeble the flicker becomes feeble; consequently the lamps and their distances from the prism should be so chosen as to afford the best illumination possible under the given conditions.

OGDEN N. ROOD.

COLUMBIA UNIVERSITY.

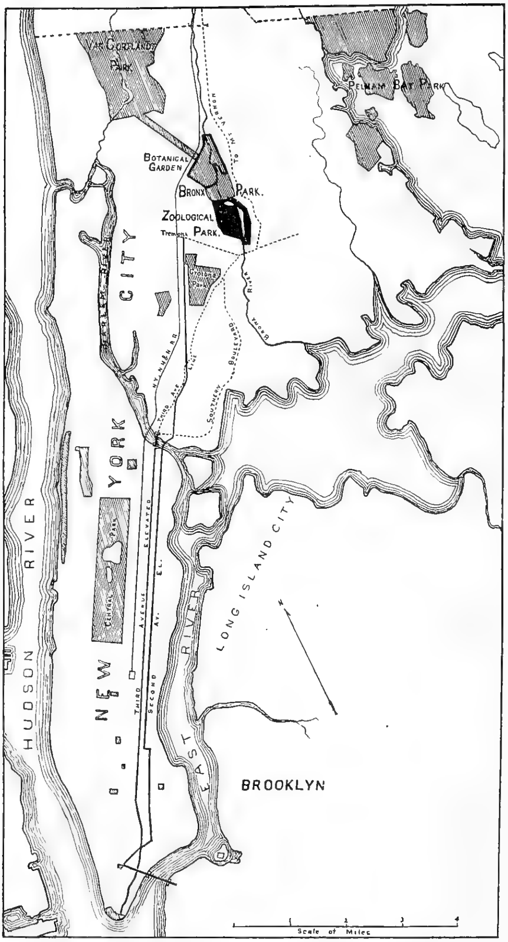
THE NEW YORK ZOOLOGICAL PARK.

MUCH progress has been made during the past year by the Zoological Society of New York, and the establishment of the Park in the near future now depends solely upon the cooperation of the city government. Under the present city administration, and especially with the policy of economy which has been generally adopted, it appears possible that the project may be somewhat delayed, although the Park Commissioners are in hearty sympathy with the project of the Society.

In the recently issued report of the Executive Committee, the following are enumerated as the chief results of the year's work: A contract with the City of New York, unanimously adopted by the Commissioners of the Sinking Fund, March 24, 1897; completion of the General Plan of the Park, and its unanimous approval by the Park Commissioners, November 22, 1897; subscription of the first $100,000 toward the gift of $250,000 from the Society to the city, completed February 15, 1898; preliminary plans of nine of the principal buildings, prepared and submitted for criticism to several American and European zoological garden specialists; increase of the membership of the Society from 118 to 600 active members.

According to the agreement with the city, $125,000 is to be expended by the city in the preparation of walks, sewers, public comfort buildings, boundary fences, etc., and a large part at least of this preliminary work is absolutely essential before the Society can judiciously expend any portion of its Park Improvement Fund of $250,000. During the next few weeks the matter will probably be decided, and in the meantime detailed plans for every division of work are being prepared with the greatest care.

The preliminary plan of the Park presented by Director Hornaday in 1896 was used as a basis for criticism and suggestion by various leading zoological experts of the country, especially by Dr. C. Hart Merriam, Mr. George B. Grinnell and Mr. D. G. Elliott, who made a careful inspection of the Park and offered a number of valuable suggestions. The preliminary plan was then approved by the Executive Committee and a close topographical servey of the Park ordered. The next step was the combination of the zoological or scientific with the



Sketch Map of New York City.
Showing the Location of the proposed Zoological Park, and present Means of Access.

landscape and architectural features; and an able committee of experts consented to serve, as follows: Mr. Thomas Hastings, of Carrere & Hastings (architects of the new public library); on engineering, Mr. W. Barclay Parsons (of the Rapid Transit Commission); and upon the general landscape development, the late Park Commissioner, William A. Stiles. Professor Chas. S. Sargent, of Harvard University, also accepted a place on this Advisory Committee, but was subsequently prevented from serving. Messrs. Heins & La Farge were appointed architects, and began to develop the details of the plans, in constant consultation with the Director. Upon the general plans of the buildings for animals, Mr. Arthur E. Brown, Superintendent of the Zoological Garden at Philadelphia; Mr. Carl Hagenbeck, of Hamburg; Dr. J. A. Allen, of the American Museum of Natural History, among others were consulted, and kindly gave their valuable time and advice. After several months of labor a final plan of the Zoological Park was completed, and on November 15th was formally approved by the Park Commissioners. The following memorandum accompanied the plan:

The fundamental principles which the Zoological Society has observed in discharging its duty toward the City of New York and the general public in the planning and the development of the Zoological Park, may be briefly formulated as follows:

1. The Zoological Park must be established on lines by which it can be made a complete success zoologically, and also satisfactory and beneficial to the public.

2. The very valuable tract of park land, consisting of 261 acres, assigned to the Society's use as a site, must not be injured in any way, either permanently or temporarily, but must at all times be regarded as a trust.

3. Even of the area devoted to animal collections, the choice landscapes are to be preserved unharmed, by locating all the large closed buildings so that they will be unobtrusive, especially from the boundary boulevards.

4. In selecting suitable locations for the numerous collections of creatures that will be required to live in the open air all the year round, it is of paramount importance that such animals should have all the advantages that are available in the nature of shade, shelter from westerly winds, dry situations, etc., in order that they may survive as long as possible.

5. So far as it be possible, it is extremely desirable that all animals living in the open air should be so installed that their surroundings will suggest, even if not closely resemble, their natural haunts.

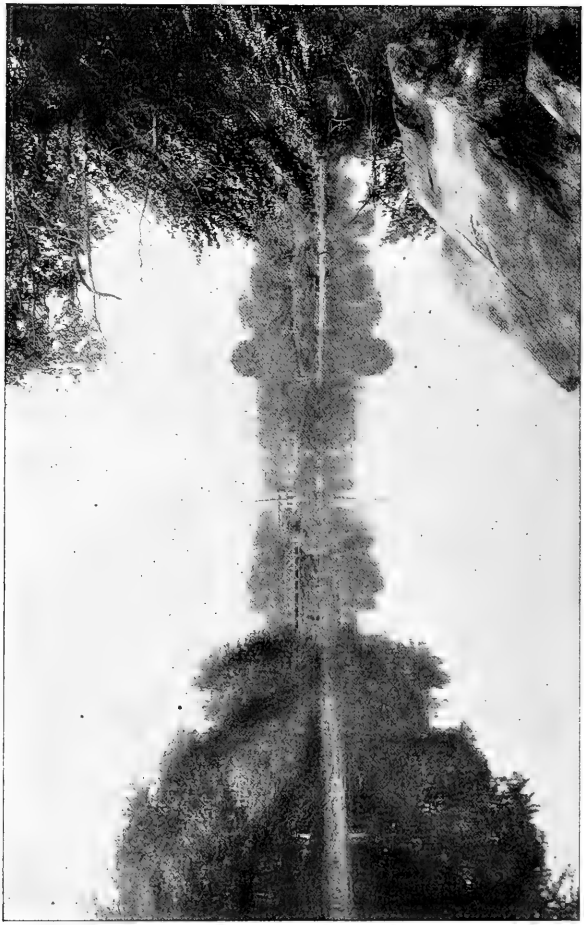
6. The fences for large animals in open ranges shall be of the lightest description consistent with the proper confinement of the animals, and all posts used shall be as unobtrusive as possible.

7. As far as possible, the general aspect of wildness which now characterizes South Bronx Park must be maintained. In other words, it is desirable that the Park should be maintained as a well-kept and accessible natural wilderness rather than as a conventional city park.

8. It is totally inexpedient and undesirable to have the area of the animals bisected in either direction by a carriage roadway, other than that projected to lead to the principal restuarant.

9. A single-track road for horseless carriages, so laid out as to reach the principal buildings and collections, but without interfering with pedestrians, is not objectionable, and will probably become necessary.

10. In order to protect and control the Zoological Park, the area for the animals, west of the Boston road, must be entirely surrounded by a light wire fence, save on the north side, where the water forms a natural barrier.



The Upper End of Bronx Lake, New York Zoological Park.

The 261 acres assigned to the Park is an especially beautiful and diversified area, combining open glades with thickets, heavy forest, natural streams and waterfalls, long areas of rocky cliffs, and traversed by the beautiful waters of the Bronx. It seems to the visitor hardly credible that such an area should have been preserved so close to a large city. It is evident that it should be developed with the very greatest care, and it is believed that the final plan of the Zoological Park will preserve all the natural beauty of this tract, and greatly enhance its interest to the people of the City and State of New York.

In regard to the zoological arrangement and the development of the plans of the buildings, the Director reports as follows:

"Our final plan is believed to locate each species as nearly as possible where nature would design to have it placed; to absolutely avoid all disfigurement of the site; to make the most of the shade which nature has provided; to enable the visitor to see the whole series of collections with the least possible amount of walking; to yield the greatest return for the money that is to be expended, and last, but not least, to yield something that is hardly to be found to an equal degree in any smaller zoological garden or park—a logical and fairly symmetrical zoological arrangement.

"In the preparation of the plans for the buildings to be erected in the Zoological Park, the Director was required to furnish to the architects a series of preliminary ground plans, and the details of such other scientific features as cage arrangement and general assignment of space. In this connection it is a pleasure to acknowledge the assistance that has been derived from certain European zoological gardens, whose buildings have furnished points that have been incorporated in our own.

"The plan of our Lion House contains several ideas drawn from the admirable London Lion House, but with one noteworthy improvement, by means of which the out-door and in-door cages are provided with free communication. The plan of our Elephant House contains features derived from the well-nigh perfect 'Palais des Hippopotames' in Antwerp. Our Antelope House contains many ideas borrowed from that in Frankfort. Our Reptile House copies several features from that in the London Garden, but many of its most important features are original.

"Our Bird House, Monkey House, Subtropical House, Small Mammals' House, Winter House for Birds, Administration Building, Bear Dens, Wolf and Fox Dens, Alligators' Pools, Burrowing Rodents' Quarters, Squirrel Installations, Beaver Pond and Aquatic Rodents' Ponds all are features absolutely new, both in design and general arrangement."

The plans of nine of the principal buildings have now been drawn with great care, but, with the exception of the Monkey House and Reptile House, they are still in the formative stage of development.

Although the principal work of the Society during the past year has been devoted to securing a firm financial basis, and to the development of a thoroughly satisfactory plan, some of the other objects have been considerably furthered.

It is our purpose to make especial provisions and facilities for artists and sculptors in the various buildings, in order to establish a school of animal painting and sculpture which shall be worthy of this city and country. As an object lesson for American cities, Director Hornaday has prepared a very careful and fully illustrated report upon "The London Zoological Society and its Gardens," which will be of interest to keepers and patrons of zoological gardens in all parts of this country. He has also made, by means of postal correspondence, an extended inquiry as to the destruction of

birds and mammals in different parts of the United States. While results obtained in this way express opinions rather than exact statistics, the column showing the percentages of decrease in bird life during the last fifteen years will be of value in arousing the national sentiment for the preservation of our rapidly disappearing wild life. The correspondence is published in detail, and a large edition of this special paper in the Annual Report has been ordered for distribution in various parts of this country where it will be of the most service.

DECREASE IN BIRD LIFE IN THIRTY STATES.

The shaded portions show the percentages of decrease throughout the States named during the last 15 years, according to the reports made to the New York Zoological Society.

Maine	52%
New Hampshire	32%
Vermont	30%
Massachusetts	27%
Rhode Island	60%
Connecticut	75%
New York	48%
New Jersey	37%
Pennsylvania	51%
Ohio	38%
Indiana	60%
Illinois	38%
Michigan	23%
Wisconsin	40%
Iowa	37%
Missouri	36%
Nebraska	10%
North Dakota	58%
District of Columbia	33%
South Carolina	32%
Georgia	65%
Florida	77%
Mississippi	37%
Louisiana	55%
Arkansas	50%
Texas	67%
Indian Territory	75%
Montana	75%
Colorado	28%
Idaho	40%
Average of Above	46%

During the past year four honorary members have been elected to the Society as follows:

Mr. Arthur Erwin Brown, Philadelphia Zoological Gardens.

Professor Daniel Giraud Elliot, Field Columbian Museum, Chicago.

Dr. C. Hart Merriam, Director of the Biological Survey, U. S. Department of Agriculture, Washington, D. C.

Dr. Philip Lutley Sclater, Secretary of the Zoological Society of London.

Public interest in this project has been stimulated by means of popular illustrated Bulletins. The Annual Report also is fully illustrated by engravings showing the Park as it is, and the London Zoological Gardens. A large colored map, executed by the Matthews-Northrup Co., of Buffalo, is included in report, and shows in detail the final plan as approved by the Society and the City.

HENRY F. OSBORN.

ENGINEERING NOTES.

THE opportunity for further improvement in the manufacture of armor-plate and consequent reduction of cost and price is well seen in comparing prices of this class of steel with those of other and more familiar sorts. With rails costing but \$15 to \$17 a ton, $\frac{3}{4}$ cent a pound, to make and selling at fifty per cent. higher figures in the market, and armor-plate at the following quotations, say at 25 cents a pound, there is obviously a grand opportunity for the mills to make money to-day and the inventor and the breaker of the monopoly to make more money later. The figures which follow are taken from bids of various makers for armor-plate to be supplied the Russian

government recently. The first two firms are English; the next four are French; the next two German and Austrian, and the next two American; the last is Russian:

	All round Price. £	9 in. £	8 in. £	7 in. £	6 in. £	5 in. £	4 in. £
Vickers, Sons, and Maxim	117	—	—	—	—	—	—
John Brown	115	—	—	—	—	—	—
St Chamond	—	98	99¼	—	—	108	110
Schneider et Cie	—	100	—	106	—	111	114
Chattillon	—	97¼	99¼	103½	—	113	—
Marrel Fieres	—	—	—	—	106¼	—	116½
F. Krupp, Essen	112½	—	—	—	—	—	—
Dillingen	112	—	—	—	—	—	—
Bethlehem Co.	106	—	—	—	—	—	—
Carnegie Co.	106	—	—	—	—	—	—
Witkowitz	90½	—	—	—	—	—	—

The highest figures are submitted by English firms. The American bidders offer the lowest terms tendered by makers whose work is well-known and of the highest existing quality. They received the last Russian contract at their own figures and in spite of the lower offers of the French and Russian firms and the close figures given by Krupp. No award is yet announced for the present tender.

FRENCH builders and users of 'motor cycles' are apparently more active and enthusiastic in that new field of enterprise than are those either of the other European nations or of the United States. Frequent reports of competitions in which high speed and long routes have been distinguishing characteristics come to us, from Paris, particularly, and in some cases the reported results are exceedingly interesting and suggestive. The 'Criterium des Motor Cycles,' from Étampes to Chartres and return, occurred early in the present month. The run was 100 kilometers. There were fifty-three entries, twenty-eight actually taking part in the contest. In fine weather, but in a strong wind, M. Leon Bollée made the run in 1 hr., 57 min., 49⅘ sec., his nearest competitor making the time 2 hrs., 20 min., 53⅗ sec. The winning vehicle had an 8 h. p. motor with two cylinders. The running speed of the victor was 51 kilometers (32 miles) an hour, unequalled by any road carriage to date, though closely approximated by steam-carriage makers sixty years ago in Great Britain. This speed is, of course, regarded as much too high for safety, on the excellent highways of France, even. The overloading of the carriage with power ruled out the motor-cycle of M. Bollée, as it was found to be in excess of the limit of weight; but this excess of power is considered by the builder to be justifiable for carriages intended to be employed in hilly countries.

R. H. THURSTON.

CURRENT NOTES ON PHYSIOGRAPHY.

PHYSICAL GEOGRAPHY OF NEW JERSEY.

THE Final Report of the State Geologist of New Jersey now reaches a fourth volume, which gives a serious discussion of the physical geography of the State by Salisbury. It replaces the first volume of this final series (now out of print), in which the topography of the State was described by Vermeule, and forms a valuable text for advanced students. After a general account of the physical features of the State, their origin is explained by means of successive cycles of erosion. The first erosion cycle developed the Schooley peneplain, now seen only in remnants on the even uplands of the Highlands, and in the long crestlines of Kittatinny mountain and of certain trap ridges. Next came the Cretaceous and Miocene submergences, separated by an erosion interval of small geographic import, and followed by the uplift which added the coastal plain to the State. An important cycle of erosion was thus introduced, during which a well-defined peneplain was developed on the weaker strata, leaving the harder as embossed ridges. A late submergence distributed the thin veneer of the

Pensauken gravels and sands over the drowned lowlands; and this was followed by an elevation in consequence of which the existing narrow valleys have been eroded in the 'pre-Pensauken peneplain.' The thoroughness of this volume only serves to emphasize the need of an elementary text, or series of brief explanatory tracts, that might go to the public schools along with the relief map of the State, already noticed in Science.

PHYSIOGRAPHIC TYPES.

The first folio of the Topographic Atlas of the United States, published by the U. S. Geological Survey, is entitled Physiographic Types. It includes the maps of well-chosen typical regions, with explanatory text by H. Gannett. The Red River plain represents a young surface; the West Virginia plateau, a maturely dissected surface; the uplands of Kansas, an old surface, reduced nearly to a plain of denudation; Shasta is taken as a young volcano; Wisconsin affords examples of moraines and drumlins; the lower Mississippi gives the type of part of a flood-plain; Maine illustrates a drowned coast; and New Jersey, a sand-reefed coast. The policy indicated by the lucidity of the text that accompanies the geological folios is here well maintained. Great educational advantage must follow from it, not only in the better understanding of the Survey publications by their mature readers to-day, but even more in leading the younger generation towards a fuller comprehension of this large and growing store of material. The aid thus indirectly given by a great national organization towards the improvement of the position of geography and geology in the schools must everywhere be heartily welcomed.

The authority that this series of folios will exercise in matters of explanation and terminology makes it desirable that the greatest care should be exercised in their preparation. There are some points in the first number that do not reach the desirable standard. For example, 'relief' is first defined in the sentence: "The land features, commonly called the relief, include all the variations of the surface * * *" It is correctly defined afterwards: "The relief, *i. e.*, the difference in height between the stream beds and the divides." More direct evidence for the denudation of the piedmont region of Virginia is found in the deep-seated origin of the rock structures now at the surface, and in the discordance between structural arrangement and surface form, than in the great age of the rocks. The 'snag' explanation of drumlins is given a greater prominence than it deserves. The account of the Maine coast is erroneous in several respects. Glacial erosion is overestimated, and there are many exceptions to the statement that the thin soil of southern Maine is chiefly derived from postglacial disintegration; the soil is often deep, consisting of glacial drift, glacial gravels and sands, and marine clays now revealed in an irregular coastal plain which the farmers there know very well. "Ocean currents also bear sand along precisely as rivers do, depositing it where their force is checked," is a generalization that may mislead many an uninformed reader. It is unfortunate that a term so well understood as 'ridge' should be used to name the almost invisible swell of a river flood-plain, particularly in the publications of a Survey that is elsewhere so careful not to exaggerate the vertical scale of its sections.

W. M. Davis.

CURRENT NOTES ON METEOROLOGY.

CYCLONES OF THE PHILIPPINE ISLANDS.

From the Observatory of Manila, which has already given meteorology many valuable publications, comes a report upon the cyclones of the Philippines, written, as Father Algué, its author, tells us in the in-

troduction, amidst rumors of wars and warlike preparations *Baguios ó Ciclones Filipinos. Estudio Teórico-práctico.* This monograph of over 300 pages is the first complete publication upon the cyclones of the Philippines. It is of especial importance just at the present time, when the Philippines, long of peculiar interest to meteorologists, are becoming of interest to the general public of this country as well. The origin, structure, movement, paths, meteorological characteristics, and prognostics, are fully considered, and detailed accounts of certain special cyclones are given. Fifteen figures accompany the report, including a chart showing the average tracks of cyclones in the East, based on the international observations from 1878 to 1888, and on the Manila observations from 1865 to 1896.

PHYSIOLOGICAL EFFECTS OF HIGH ALTITUDES.

A SHORT paper by Douglass on the *Effects of High Mountain Climbing* (Appalachia, Vol. VIII., No. 4, 1898) summarizes the more important symptoms of mountain sickness as noted by previous climbers, and adds a few notes from the author's own experiences. The author is of the opinion that in trips which require two days to reach the summit of the mountain, as, *e. g.*, the ascent of Popocatepetl and Orizaba, the night should be passed at an altitude where mountain sickness is not likely to prevent sleep, that is, at about 13,000 ft. The increased discomfort from mountain sickness during the night, and the fact that all the symptoms become exaggerated with increasing elevation above sea level, make it advisable to sleep at as low an altitude as possible.

FOG ON THE NORTH ATLANTIC OCEAN.

ON the *Pilot Chart of the North Atlantic Ocean* for May, 1898, a new scheme for indicating the probable prevalence of fog is adopted for the first time. Instead of showing the regions of fog in one shade of coloring, as has been done hitherto, the present scheme gives a much more detailed forecast. Seven different styles of blue shading are now used, indicating seven degrees of probable duration of fog, in percentages. These percentages are as follows: 10%–20%, 20%–30%, 30%–40%, 40%–50%, 50%–60%, 60%–70%, and over 70%. That this more detailed forecast of fog duration will be very acceptable to mariners there can be no doubt.

CLOUD STUDY AND PHOTOGRAPHY.

AN attractive little book of eighty pages, entitled 'La Photographie et l'étude des nuages,' by Boyer, presents, in four chapters, an account of the classification of clouds according to the International System; of the application of photography to cloud study, and of the calculation of cloud heights and velocities from the photographs. There are several good illustrations of cloud forms, reproduced from the cloud sheet of our Hydrographic Office, from the 'International Cloud Atlas,' and from photographs taken at the Observatory at Trappes.

R. DEC. WARD.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

ETHNOGRAPHY OF WESTERN ASIA.

THE races of western Asia were the subject of an important communication by M. Chantre to the French Association for the Advancement of Science at its last meeting. His conclusions were based upon about 25,000 measurements, including those of 100 women of high cast taken by Madame Chantre. They were altogether derived from 16 different stocks. They differed widely, showing that the population is from very varied sources. In reference to the cephalic index, for example, we have, on the one hand, the Kurds with an average index of 72, and on the other the Baktiars,

whose index averages about 90. On the whole the broad-skulled type predominates, being, as compared to the long-skulled type, in the proportion of 8 to 3. The complete publication of these important results has not yet been made.

BIBLIOGRAPHY OF PERU.

THE 23d publication of the Field Columbian Museum is a 'Bibliography of the Anthropology of Peru,' by Dr. George A. Dorsey. It is a neat octavo of 206 pages and must contain nearly 3,000 titles. This is proof enough of its value to students, and we venture to hope that it will not be the last work of the kind by its author, though in his preface he says it will be.

How impossible it is, however, to reach completion in such a task! Confining myself to the works in my own library, I find that Dr. Dorsey does not mention the papers on Peruvian mummies by Schuch and Cornalia, nor that on Peruvian gems by Blondel, nor any by the distinguished collector, Dr. Contzen, nor the valuable archæological catalogue of Macedo, nor the essays on Peruvian mythology by Lafone, and, more painful to relate, he says nothing of my articles on the Puquina language, omitting also those of Grasserie on the same tongue. This merely shows that the greatest care sometimes fails.

THE LAMP OF THE ESKIMOS.

IT has been noted that no form of lamp (with one doubtful exception) was known in ancient America south of the Eskimos. These possessed one from time immemorial. They could not, indeed, live without it. A study of it is presented in the *American Anthropologist* for April by Mr. Walter Hough. He considers it an independent invention. The rudest are merely stones collected on the beach with natural concavities in which the fats or oil can be poured and the wick laid at the side. Other stones were hollowed out to imitate these. At St. Lawrence Island lamps of pottery are frequent. The size and form of the lamps curiously enough bear so distinct a relation to the isothermal lines that it is possible by comparison to assign the geographic position to any specimen.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

SUMMER SCHOOL OF THE ILLINOIS BOTANICAL STATION.

A SUMMER school of biology will be held at the Illinois Biological Station, Havana, Illinois, under the auspices of the University of Illinois, adapted to the purposes of university students; the instruction will also be carefully adjusted to the needs of teachers of biology wishing an opportunity for personal studies, in field and laboratory, of the plants and animals of a peculiarly rich and interesting situation and of the methods of modern biological station work. Four regular courses will be offered to organized classes, two in zoology and two in botany; and in addition to these opportunity will be given to students of experience to take independent work on special subjects, and to visiting investigators to pursue their personal researches at the station with the use of its equipment. The regular courses will be open to all who satisfy the management of their ability to do the work. The session will begin June 15th and continue four weeks, but members of classes may continue their work independently until August 1st. Visiting investigators may come at any time and remain until September 15th, and teachers may enter at any date preceding July 1st.

Visiting investigators will be given tables on the floating laboratory of the biological station. They will find in the locality a very rich fauna and flora in a greatly varied environment. Exceptional opportunities are offered for work on the lower algæ and the fleshy fungi. Over ninety species of Mycetozoa occur at Havana during the summer months. The abundance of Protozoa, Rotifera, Entomostraca, aquatic insects, planarians, oligochæte and parasitic worms, Mollusca—especially Unionidæ and

Bryozoa—and the ease with which material can be obtained, greatly facilitate morphological, experimental or systematic studies upon these forms. Havana is also an important fishing point, and the common fish and turtles of the Mississippi Valley can be obtained in abundance. The library facilities of the University and of the State Laboratory of Natural History will be open to investigators. This makes available the leading morphological journals and an exceptionally complete collection of the literature of fresh-water fauna and flora. Necessary laboratory equipment of glassware and reagents will be provided, though visitors are requested to furnish their own microscopes, expensive reagents, and alcohol for collecting purposes. Lists of literature and other desiderata should be in our hands by June 10th. The equipment of the Biological Station—steam-launch, rowboats and collecting apparatus—will be available for field work.

For the general objects, methods and organization of the school the Director of the Biological Station, Professor S. A. Forbes, is primarily responsible. The session will be under the immediate management of Dr. C. A. Kofoid, Superintendent of the Station and assistant professor of zoology at the University, who will also supervise and provide for the work of advanced students and investigators. The regular zoological courses, major and minor, will be taught by Professor Frank Smith, assistant professor of zoology at the University, and the botanical courses by Mr. Charles F. Hottes, University instructor in botany. The services of other members of the Station staff and of the University biological departments will be drawn upon for instruction in the special lines with which they are most familiar.

A fee of $10 a month will be charged each student and each occupant of a biological station table. Membership in the regular classes will be limited to fifty students and the number of visiting investigators to twelve. Those purposing to attend will secure their places and confer a favor upon the management by making early application, accompanied by a statement of their preparation for the work. Other things being equal, college and university students and teachers of biology in the public schools will be given the preference. Further particulars may be obtained from Professor S. A. Forbes, Urbana, Ill.

THE THIRD INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

DR. H. W. WILEY, Chairman of the American Committee of Organization for the Third International Congress of Applied Chemistry, to be held at Vienna beginning on July 28th, writes that the Organization Committee requests the American chemists wishing to send contributions to that Congress, either papers or reports of any description, to transmit the full title, together with an abstract of the papers, as soon as possible, to Professor Dr. F. Strohmer, IV/2 Schönburgstrasse Nr. 6, Wien, Austria. It is desired to publish the full program of the papers to be presented in the near future, and American chemists are earnestly requested to send forward their contributions without delay.

A local committee has been formed at Vienna for the purpose of securing agreeable and cheap dwelling places for foreign members during the continuance of the Congress. Those wishing to engage such places should address: Wohnungscomite des III internationalen Congresses für angewandte Chemie, Wien IV/2 Schönburgstrasse 6.

American chemists are also informed that, on account of the Jubilee Exposition to be held in Vienna from the 7th of May to the 8th of October, this year, the Austrain railroads are prèpared to furnish round-trip tickets to all points in Austria-Hungary at greatly reduced prices. A further communication from the Railroad Committee will be made to American chemists in a short time concerning this matter. The North German Lloyd Steamship Company has also made reductions in fares to members of the Congress, regarding which further information may be obtained from Dr. Wiley.

GENERAL.

ARRANGEMENTS have now been made for the day to be spent at Harvard University during the Boston meeting of the American Association for the Advancement of Science. The various buildings and departments of the University will be opened for inspection. A

luncheon will be served in Memorial Hall, and later in the afternoon the corporation will give a garden party and tea in the Hemenway Gymnasium. At eight o'clock in the evening President Eliot will address the Association in Saunder's Theatre.

A CIRCULAR has been issued by Professor Foster, President of the Fourth International Congress of Physiologists, which meets at Cambridge from August 21st to 26th, giving information regarding accommodations. Many of the colleges have offered rooms for the use of members which will be furnished free of charge, beyond a small sum for attendance. Ladies cannot, however, reside in the colleges, but lodgings in the town are provided at a cost of less than $1.00, including light and attendance, and meals can be taken in the college halls. Those wishing to secure lodgings or hotel accommodation should address Dr. Shore, the Local Secretary, at the Physiological Laboratory, Cambridge.

THERE will be held, as we have already noted, a biological exhibition in connection with the visit of the British Association to the city of Bristol. It is proposed to hold this exhibition in the gardens of the Bristol and West of England Zoological Society, and to offer as complete an exhibition as possible of recent investigations into the life history of animals and plants. A working committee has been formed and Sir John Lubbock has consented to open the exhibition.

AT a meeting of the Washington Academy of Sciences, held on May 27th, nineteen new members were elected. Most of these were nominated by a committee acting on behalf of the Medical Society of the District of Columbia, recently added to the group of affiliated scientific societies represented in the Academy.

A TRIO of eminent German travelers and anthropologists are now in this country for the purpose of study. Dr. Karl von den Steinen, widely known through his travels in South America, and his two important works and minor publications relating thereto, has recently reached the eastern United States after a trip through the Southwest. Dr. Paul Ehrenreich, of Berlin, is now in New York en route to the Pueblo country. Dr. Albrecht Wirth, of Frankfort, known through researches in Eastern Africa, and more recently through a work on Formosa, has just returned from the Far East, through Corea and Siberia. He is now in Washington.

DR. F. W. TRUE and Professor W. H. Holmes, of the United States National Museum, have recently gone to Omaha to supervise the final installation of the Smithsonian exhibit and to attend the formal opening of the Exposition. The Smithsonian exhibit at Omaha is rather more limited than were the displays at Nashville and Atlanta, owing to limitations in space and funds; but the arrangement is considered highly effective and satisfactory.

THE Geological Department of the Johns Hopkins University has just closed an encampment of several weeks near Cumberland, Maryland, in the heart of the Appalachian Mountains. Work was suspended in Baltimore during the period of the camp, special courses being given at Cumberland, both by the regular corps of instructors and by lecturers secured from the scientific bureaus in Washington. Complete instrumental outfits employed in geological, topographical, climatological, hydrographical and agricultural investigations were installed at the camp, special lectures being given upon their uses. In addition to practical work along geological and topographical lines, meteorological observations were taken twice daily by the students under the direction of an observer detailed by the United States Weather Bureau, the streams were gauged and the velocity and volume of their outflow determined, and the conditions of the soils in their temperature and moisture contents were examined daily under competent supervision. Among those who were present at the camp and who aided Professor Clark and his associates in the work of instruction were Messrs. Bailey Willis, H. M. Wilson, O. L. Fassig, E. G. Paul and C. W. Dorsey, of the Washington bureaus. It is planned to continue practical field work in this manner in subsequent years.

THE fourth annual address before the Botan-

ical Seminar of the University of Nebraska was given by Dr. Charles R. Barnes, of the University of Wisconsin, on Saturday evening, May 21, 1898. The Conjugatæ and higher Bryophyta were cited as illustrations of 'Evolutionary Failures,' the subject of the address. The Seminar will publish the address in the near future.

THE department of botany of the University of Nebraska has prepared two 'Laboratory Units' for high school botanical laboratories, for exhibition in the Trans-Mississippi Exposition. Each includes those pieces of apparatus which are absolutely necessary for the student in the high school who is preparing to enter the University. The first of the 'units' is supplied by an American maker for $23.00, and the second is imported duty free by another dealer for $20.00. School officers can thus readily determine what to purchase and what the expense will be.

DR. HERMANN SCHAPIRA, professor of mathematics at the University of Heidelberg, died at Cologne on May 9th, at the age of fifty-seven years. The death is also reported of Mr. Maurice Hovelacque, Secretary of the Geological Society of Paris.

MR. ARTHUR E. KENNELLY has been elected President, and Mr. Ralph W. Pope has been re-elected Secretary, of the American Institute of Electrical Engineers.

PROFESSOR KALKOWSKY has been appointed Director of the Mineralogical, Geological and Ethnological Museum in Dresden.

PROFESSOR MAX VON PETTENKOFER, of the medical faculty of the University of Munich, has been elected a corresponding member of the Berlin Academy of Sciences.

PROFESSOR W. ROUX, who holds the chair of anatomy at Halle, has been elected a corresponding member of the Turin Academy of Sciences.

DR. EDWARD STRASBURGER, professor of botany at Bonn, has been elected a foreign member of the Danish Academy of Sciences.

AN address and some valuable plate were presented to Sir William Stokes on May 7th, on the occasion of the completion of the twenty-fifth year of his professorship at the College of Surgeons, Dublin. In the evening Sir William Stokes was entertained at dinner.

THE Philosophical Faculty of the University of Göttingen has awarded the Otto Vahlbruch prize for the greatest advance in science during the past two years to Professor Röntgen, of Würzburg. This prize was founded in 1896 and is of the value of 9,200 Marks.

DIE Senckenbergische Naturforschende Gesellschaft, of Frankfort, has awarded its Stroebel prize to Dr. Camerer, of Urach, for a book on the Metabolism of the Child.

THE Berlin Society for the Advancement of Industry offers several prizes for work to be submitted prior to November, 1898. One of these is a silver medal and six thousand Marks, for electrolysis applied to mining, and one a first prize of 4,000 Marks and a second prize of 3,000 Marks for a method of measuring the amount of steam passing through a pipe. The Society further offers in 1899 the Tornow prizes (5,000, 3,000 and 2,000 Marks) for a history of the metals, which must not exceed 200 pages in length.

WILLIAM WESLEY & SON, London, have issued a catalogue offering for sale a large number of works on astronomy from the libraries of Rev. A. Freeman, M.A., F.R.A.S.; A. Marth, F.R.A.S., and J. R. Hind, F.R.A.S., late Superintendent of the Nautical Almanac Office, London.

WE are glad to note that at the annual meeting of the London Anti-vivisection Society the Chairman said that many felt disheartened at the slow progress of the movement; that the society had to struggle against want of sympathy; that they deplored the apathy of the public in the matter, and a resolution was passed expressing unqualified dissatisfaction with the existing act regulating vivisection, and with its administration by the Home Office.

THE *Iowa Health Bulletin* publishes letters given by 'doctors of medicine' in support of applications for pensions, of which the following are examples:

———, June 8, 1896. Dear Sir,

Yours received I treted Wm. Akens after he cum Hoam from the serfis for polypup in his nosee and

Running soar in his pastur. The polypup from the nite are and exposure the wonde cum from the cick of a hoars. ———, M.D.

———, February 30, 1897. Sur,

I surtify I treted the sed sojer fum 18888 to Date —— foarmerly his stumik tub was jined to his nervious sistem but now it air rotted off cosing grate expectoring and hard of breth. Your Obt. servent

———, M.D.

AN examination will be held to fill a vacancy in the grade of Chemist at the New York custom house on June 9th. The salary of this office is $2,400.

THE New York Library Association held its annual meeting at Utica, N. Y., on May 25th and 26th.

THE 36th University Convocation will be held at Albany on June 27th, 28th and 29th. Among the subjects proposed for discussion are: Extension of elective system in high schools and academies. Should the four-year high school course be enforced as the minimum prerequisite for all degree courses? Should a minimum for conferring degrees be fixed by law? How low may admission requirements be made without forfeiting the right to the name college? What recognition should colleges and universities give to diplomas of State normal schools? What, if any, college studies should be regarded as constants to be pursued in every course? In courses leading to liberal arts degrees what credit should be given for studies in engineering, music and fine arts? Should high schools regularly offer instruction in domestic science and in business, or should this training for particular callings be relegated entirely to special schools? Educational functions of wall pictures, photographs and lantern slides as coordinate with books in giving either information or inspiration. The influence on boys and girls of reading daily newspapers. In connection with the reception in the State Library on June 27th a new Indian Museum will be opened for inspection.

IN noting the appointment of Professor Keeler to the Lick Observatory *The Revue Scientifique* pays the following compliment to the atmosphere of Pittsburg:

L'Observatoire d'Allegheny ayant un ciel plus transparent que celui du Mont Hamilton, M. Keeler avait offert de rester à la tête du premier de ces établissements si de généreux amis de la science souscrivaient un million de francs pour agrandir et doter l'Observatoire.

THE third meeting of the Pan-American Medical Congress is to be held in Caracas, Venezuela, in Christmas week, 1899.

IN an interesting article in the May *Forum*, Professor Willis L. Moore states that the Weather Bureau intends to establish tentatively fifteen or twenty stations between the Alleghanies and the Rocky Mountains during the present spring, and to make special effort to secure observations at the same hour at a high level from all the stations, so that the meteorological conditions at that altitude may be compared with those prevailing at the surface of the earth. If we are successful in attaining the desired altitude at enough of our stations each day to give the data from which a synoptic chart can be constructed we shall then be able to map out not only the vertical gradients of temperature, humidity, pressure and wind velocity, but also the horizontal distribution of these forces at two levels—one at the earth's surface and the other at the height of one mile. It may be that after this work is done only negative knowledge will be acquired, but even then the work will not have been in vain. It will be an instructive study to note the development and progression of storms and cold waves at this high level. At that altitude the diurnal variations cease; there is but little change between the heat of midday and that of midnight, so that storm conditions may be measured without the confusing effects due to immediate terrestrial radiation.

THE Botanical Club of Barnard College has handed to the Treasurer $500 to form the nucleus of a fund for the equipment of a botanical laboratory to be known as the Emily L. Gregory Botanical Laboratory.

MR. JOHN NICHOLS has added the sum of $45,000 to the $200,000 which he gave about two years ago for a library building for the city of Providence.

THE State Institute for Serum Research is being removed from Berlin to Frankfort, that

city having undertaken to erect a building for the Institute at a cost of 125,000 Marks.

THE annual horticultural exhibition was held in Paris from the 18th to the 25th of May and a Congress of Horticulture met in conjunction with the Exposition on May 20th and 21st. The Royal Botanic Society, London, held an exhibition of plants and flowers in their gardens at Regent's Park on May 11th.

WE learn from *Natural Science* that Mr. Edouard Foa has travelled across Africa by the basin of the Zambesi, Lake Tanganyika and the Congo, and has brought back numerous specimens of anthropological interest from the region of the great lakes. Dr. Hugo Bücking and Dr. L. van Werneke have started for an eight months' expedition to the Netherland East Indies on behalf of a Dutch Society.

WE receive monthly the *Sei-i-kwai Medical Journal*, edited and published by the Society for the Advancement of Medical Science in Japan, the articles of which, partly in English and partly in Japanese, are doubtless instructive to the Japanese, while those in English are certainly amusing to the English reader. The general style may be gathered from the following:

"Diseases of the animal sphere (or the nerves, senses and muscles). Regarding Japanese pathological constitution the writings of medical and elthnographic authors are not lacking in general remarks which are meant to express in the usual sense. * * * * It would also be an essential task of the surgeon to separate such easings of the treatment of wounds as really are due to censtitutional causes, from the consequences of the possibility that perhaps the causes of infection working against the healing art is some way different extra European countries. * * * * The spleen is all malarial, typhus, variola diseases and in those called *και ε'ξοκγν* splenetid diseases, the seat of strong swelling and all corresponding symptoms. Let us observe here that unusually great swellings of the spleen are seldom found, either in post-mortion or clinical examination."

UNIVERSITY AND EDUCATIONAL NEWS.

IT is said that Mrs. Phœbe Hearst will erect a building for mining engineering for the University of California at a cost of $300,000.

MR. HENRY WILDE, F.R.S., has proposed to endow in Oxford University a readership and a scholarship in mental philosophy. They are to be designated the Wilde readership and the John Locke scholarship.

HOBART COLLEGE, Geneva, N. Y., received $6,000 for a scholarship by the will of Mrs. Augusta M. Williams, of Newport, R. I.

THE appointments for the coming year in the botanical department, Cornell University, are as follows: Dr. E. J. Durand is reappointed instructor in botany and assistant curator of the Cryptogamic Herbarium, and Mr. K. M. Wiegand, assistant in botany and assistant curator of the Phaneogamic Herbarium. Mr. B. M. Duggar, now assistant cryptogamic botanist to the Experiment Station, has been appointed instructor in botany, with special reference to experimental plant physiology, his time to be divided between instruction and work in the Experiment Station. Two graduate assistantships in botany have been established, the holders to divide their time between assistance and investigation. Mr. W. A. Murrill, B.S., A.M., the present scholar, and Mr. G. T. Hastings have been appointed to these positions for the coming year. Besides these, a fellow, or scholar, is appointed in the department.

THE second summer session of the New York State Library School, Albany, of which Mr. Melvil Dewey is Director, began this year on May 30th, and will continne in session for five weeks.

AMONG the docents who have recently qualified are Dr. Fischer in anatomy and Dr. Mayer, of Vienna, in chemistry at the German University at Prague; Dr. Formanek in applied medical chemistry in the Bohemian University at Prague, and Dr. Haussner in mathematics in the University at Giessen.

DISCUSSION AND CORRESPONDENCE.

COLOR-VISION.

IT is not often that a letter appears in SCIENCE that presents the particular combination of characteristics of one of the recent communications on Color Vision. Professor Titchener says expressly that until the recent papers of Müller in the *Zeitschrift für Psychologie* on Her-

ing's theory of Color Vision he has been content for several years to know the subject only in the compendiums of Helmholtz, Wundt and Hermann, and in the original paper of Hering of 1874, and yet he finds himself able to lay down the law in an *ex-cathedra* fashion that one would usually not be willing to indulge in, in regard to a confessedly undecided question, after a long devotion to the subject. That his reading has been cursory, and has been apparently to a certain extent forgotten, is evident from his making in a few lines such mistakes as to attribute the idea of the shift of excitability in photo-chemical substances to König, and to refer to the Helmholtz theory as a three-fibre theory. Fick is usually and not improperly credited with the idea of the 'shift of excitability,' as it is he who first made much of it in the explanation of color-blindness, but the idea is originally due to Helmholtz himself, and occurs already in the first edition of his 'Optics.' To say, therefore, of Helmholtz's theory that 'its original and most attractive simplicity has been given up in favor of König's shift of excitability' is to show a rather unusual degree of ignorance of the facts of the case. It is also doing much injustice to the Helmholtz theory to designate it as a three-fibre theory; the assignment of the three chemical substances to three separate fibres was, in the first edition of the 'Optics,' expressly stated to be merely a mode of facilitating speaking about them, and since the time of its experimental disproving in Helmholtz' own laboratory it has naturally been abandoned by him.

The present discussion of color-vision in SCIENCE has been occasioned by Professor Patten's having had the temerity to bring out an entirely new theory, the main feature of which is that it is an endeavor to take account of a peculiarity of the structure of the retina which is certainly there, and which as certainly does not exist without having some function. Professor Patten's full paper on the subject has not yet appeared; when it does it will no doubt receive a due measure of attention from the physiologists and the anatomists, to whom it makes its chief appeal; any great psychological inadequateness is hardly to be looked for, at the hands of its author, in view of the full discussion which considerations of this sort have received in recent years. But it seems hardly courteous to condemn a theory before it has had a chance to be heard; any new theory, from the nature of the case, makes its appeal to those only who have the leisure and the open-mindedness (or the idle curiosity, as it may turn out to have been) to give it a fair share of attention. For a fresh theory to be set down as unnecessary and absurd is no new experience; the most recent (and classical) example of the sort is the notice with which Kolbe greeted Van 't Hoff's conception of the different positions of atoms in space, which has since assumed such fundamental importance for chemistry. He said: "If any one supposes that I exaggerate this evil [of erratic speculation] I recommend him to read, if he has the patience, the recent fanciful publication of Van't Hoff and Hermann" (Hermann being the German translator). It cannot, therefore, be looked upon as altogether a bad omen that the first feeling excited by a new theory is one of irritation and impatience.

My own theory met with the great good luck that, at the end of a year after it was brought out, the President of the British Association happened to take, as the subject of his presidential address, a topic which included color-vision; after full and careful discussion of the subject, he stated that the known facts in the case (and especially those recently discovered) were best explained by my theory. It is a piece of good fortune, again, that the physiologists of this country have happened just at this time to bring out a large and important general work on Physiology; this has given Professor Bowditch occasion to give my theory generous space and a very fair showing. As a Vice-President of the American Association, Professor Le Conte Stevens has also happened to have color-vision for the subject of his inaugural address; and the author of the best English compendium on sight, Professor Joseph Le Conte, has happened to bring out a new edition of his little book; I have to thank them both for the courteous treatment which they have given my attempt to account for the phenomena of the sensation of light. All this I regard as a piece of good fortune, such as does not always attend upon

merit in this too busy world, and I hope that Professor Patten, if he happens to have hit upon a fruitful idea, will have an equally early opportunity to secure a hearing.

While my theory has had much good luck in the way of a favorable reception, it has hitherto been rather lacking in the honor of being attacked. I am, therefore, very glad of the opportunity which is now given me for elucidating some of its features. Professor Titchener disposes of my hypothesis in summary fashion by saying, first, that my assumed molecules have a suicidal tendency, and, second, that there is experimental evidence against the theory. The reply in the case of both of these counts is very simple. I take the second one first:

1. There is no experimental evidence against my theory. There is experimental evidence against the four-color component theory of Donders, but it does not hold against my theory, in which there are not two different kinds of white-sensation. Moreover, the attempt which has been made to show that this same evidence does not hold equally against the four-color theory of Hering can hardly be said to be successful.

2. It is incorrect to say that I assume, among the properties of my photo-chemical substance, a suicidal tendency; it should be said at most that it has a *semi-suicidal* tendency. The photo-chemical substance which I assume is as stable as any other physiological substance in its first estate; it is only that it becomes unstable after it has suffered a partial decomposition. As a matter of fact, after we have had a vision of blue for a certain length of time we find that it is followed, even though the eyes be closed, by an after-vision of yellow. This is a marked defect in the optical apparatus with which nature has provided us, and a defect from which we do not suffer (to any appreciable extent) in the case of the other senses; the sound-sensation of a given note is not followed by an after-clap of a definite other note. Nature might have done much better for us if she had provided some light-process which was not open to this source of error, but as she has not we must do the best we can to make out the character of the process which she has given us. Whatever that process may be, it is plainly something such that, after the external world has sent in to us information regarding a given colored surface, retinal equilibrium has to be restored by a subjective vision of the complementary color, even at the cost, if the eyes be open, of making objects which are really white take on a deceptive appearance of being colored. This fact of nature is mirrored in my theory by supposing that after having undergone a partial decomposition the photo-chemical substance concerned becomes unstable and breaks down completely. This is *zweckmässig*, because the retina becomes in this way a *tabula rasa*, and is thus able to give us correct information regarding the color that next impinges upon it. It had not occurred to me that the idea of a chemical compound which, on being partly decomposed, left an unstable residue was so recondite a conception as to need to be fortified by authority or by example, and, upon consulting the chemists whom I have access to, I find that I am right in this view. But if examples are needed they can easily be given in any quantity. Many unstable phenols, as pyrocatechin and pyrogallic acid, form stable compounds when treated with acid chlorides as benzoyl chloride or acetyl chloride. When these compounds are decomposed, so that benzoic acid or acetic acid, as the case may be, is formed, and the stable acids are removed, the very unstable phenol is left in solution. And it is not even necessary to go so far as to organic chemistry to find instances. So elementary a process as the removal of an atom of oxygen from sulphuric acid leaves an unstable remainder which gradually separates into water and sulphurous anhydride.

It cannot be too much insisted upon that the after-image which follows the vision of a colored surface is something peculiar and consequently demands something *sui generis* in the chemical conception which is to account for it. Müller, in fact, points out that, if the after-image is to be explained by the play of assimilation and dissimilation, the evident objection presents itself that corresponding after-effects ought to occur in other regions of the animal mechanism as well. The only way he has of meeting this objection is to say that *any* explanation of the

visual process which was based upon *general* properties of the nervous substance would be open to the same objection. This is true, and it applies to Müller's own explanation of the phenomenon in question with peculiar force. But the conclusion to be drawn is not that one visual theory is sure to be just as good as another, but rather that that theory which posits a chemical process which is *not* exactly like what goes on everywhere else in the body has by so much the advantage over another theory. The idea of a photo-chemical substance which is unstable after a partial dissociation, which it is as far as possible from being a remote idea to the chemist, is *just as far* removed from our conception of other physiological processes as it *must be*, in a well-devised theory, in order to account for anything so extremely distinctive as is the visual after-image.

But even though it had been necessary to go very far afield for the conception of a semi-suicidal chemical substance, this could not have been counted, by any one who had given a moment's consideration to the subject, as a point of superiority on the part of Hering's theory over mine; for his assumed photo-chemical substance is 'suicidal' from the start. If blue is the color of assimilation, then after we have looked at a blue surface for a few moments there has been piled up in the retina, according to Hering, a large amount of the blue-yellow substance, and it is the going to pieces of this immediately afterwards which is the cause of the after-image; this assumed process is not in itself an objection to the theory, but it is 'suicidal' to the last degree.

Professor Müller's recent papers in the *Zeitschrift für Psychologie* are a monument of learning and acumen, as I have already said in the pages of *The Psychological Review.* How far they are from substituting for the original theory of Hering a theory which can lay any claim whatever to being considered an adequate account of the phenomena of color-vision I am about to show in connection with a general discussion of color theories. Meantime I rejoice in the fact that Professor Titchener has renewed his study of the subject of color. It is to be hoped that this will lead him to remodel the brief statements regarding color which are found in his book on Psychology; what he says there (while it is not incomprehensible to one who has the clue to his secret meaning) must seem contradictory and confusing in the extreme to the ordinary reader, and certainly constitutes a serious blemish in a book which is otherwise not simply a good text-book, but a valuable contribution to the science of psychology.

C. Ladd Franklin.

Baltimore.

A PRECISE CRITERION OF SPECIES.

To the Editor of Science: I thank you for the suggestions contained in your kind discussion in Science, No. 178, of Mr. Blankinship's and my paper on a 'Precise Criterion of Species.' Our paper was concerned with a method which, if applied, will constitute a small, but, we think, important, step toward giving greater precision to the defining of particular species and to the distinguishing of varieties from species. To my mind the only important objection urged so far, an objection which was anticipated, is that it is impracticable to use in systematic work so great precision as our method calls for; it takes too much time and too large a number of individuals. *A priori* argumentation cannot dispose of this formidable objection; only the demonstrated advantage of the method in practice can avail against it. I should like to urge anthropologists, mammalogists, ornithologists, ichthyologists, malacologists and others who have already gone some way in the direction of applying statistics to species to put the method to practical test. Mr. Blankinship and I are doing so. I should be very glad to assist those who meet with difficulties in the application of the method, as, for example, in the measurement of color and complex forms. The ingenious naturalist will find, however, as anthropologists have found, few, if any, specific differentiæ which are not measurable.

C. B. Davenport.

ELECTRICAL ANÆSTHESIA.

To the Editor of Science: While making some experiments on the sensations derived from sinusoidal currents I noticed (April 12, 1898) that anæsthesia of the tissues resulted

from currents of high frequency, the condition lasting for some time after the removal of the electrodes. While in this condition the finger could be pricked with a pin without any resulting sensation except that of dull contact. Sensitiveness to cold was also removed. The investigation has been continued and has shown the possibility of employing a sinusoidal current of high frequency as an anæsthetic. Full details as to the requisite frequency and intensity will be published later.

E. W. SCRIPTURE.

YALE UNIVERSITY,
NEW HAVEN, CONN., May 25th.

SCIENTIFIC LITERATURE.

The Sun's Place in Nature. By SIR NORMAN LOCKYER. London and New York, The Macmillan Company. 1897. Pp. 360. Price, 12 shillings.

The character of this latest work of its eminent author might, perhaps, be misunderstood from its title. It discusses the Sun's place in the order of evolution of the stars, and not in relation to the solar system. It is, therefore, to be classed as a book on stellar astronomy, and is to a considerable extent based upon a course of lectures recently delivered by the author at the School of Mines in London. The nature of the work may best be shown by quoting in full the conclusion: "I am not aware that any more crucial test than the foregoing can be applied to the rival schemes of stellar classification, and, as I hold that the result of its application is entirely in favor of the one which assumes the existence of some stellar bodies which are increasing their temperature while others are reducing it, the Sun's place in Nature must be regarded as near that occupied by Arcturus and Capella, and very far separated from that occupied by α Cygni, γ Cygni, and α Tauri. Nor is this all, the origin of the Sun in a nebula not exclusively gaseous, but only containing gases among its constituents, is greatly strengthened by the extended study of the classification problem which has occupied the last few chapters. Along all lines, then, the fundamental requirements of the Meteoritic Hypothesis have been strengthened by the later work."

The book may be regarded, then, as a sequel to 'The Meteoritic Hypothesis,' which appeared in 1890, and is intended to reply to the criticisms of the earlier work, as well as to present the author's view of the bearing on that hypothesis of the relevant discoveries in the intervening years. It is, therefore, not a book for the instruction of the general reader, unless he has a taste for argumentative reasoning, adduced in behalf of a theory which has not met with general acceptance. It is written in Sir Norman's easy style, and may readily carry the reader who is not critical along to the conclusions of the author.

An interesting account is given of the discovery of terrestrial helium and the investigations of its spectrum from various minerals, in which the researches of the author were early and important. Some seventy minerals were examined in his laboratory at South Kensington, and the D_3 line of helium was detected in the spectrum of sixteen of them.

It is an essential feature of the Meteoritic Hypothesis that nebulæ are meteoritic in their nature, and that they pass into the stage of 'stars' as the meteoric 'swarms' become more condensed. Accordingly considerable space is devoted to the chemistry and nature of the nebula and their relation to stars. Professor Lockyer has himself obtained very successful photographs of the Orion nebula, and he gives a list of 54 lines on a plate taken in 1890. If there is any connection between nebulæ and meteorites it would certainly be expected to reveal itself in some resemblance of their spectra. As a matter of fact, however, aside from hydrogen and helium, which are abundantly represented by lines, the only elements which Professor Lockyer identifies are calcium (three lines), iron, carbon and magnesium (one line each). Now Keeler's measures have demonstrated that the chief nebular line does not coincide with the magnesium line, and still less do the remaining lines agree in wave-length with the lines of the elements mentioned. Thus it appears that there is an entire absence of spectral similarity between nebulæ and meteorites, except that both contain the universally prevalent hydrogen.

The references made to the work of Dr. Huggins, especially in connection with the

spectrum of the nebulæ, can hardly be accepted as fair to that eminent investigator and pioneer in that line.

An interesting account is given of the appearances of the temporary stars, or '*Novæ*,' with their spectroscopic history, in which the observations of the author properly take a prominent place. Chapter XIV. is entitled 'How the hypothesis has fared,' referring more particularly to the bearing of the recent work on *Nova Aurigæ* upon the meteoritic hypothesis. The last quarter of the work discusses the problem of stellar classification. The principal contention of the author is that a spectral classification should provide both for stars that may be growing hotter as well as for those that may be growing cooler. The implication is that the adoption of this principle requires the acceptance of the meteoritic hypothesis, an implication recurring in other parts of this work. The necessity is, however, by no means obvious.

In the diagrams to show the difference in the spectra of stars considered by the author to be of increasing, and those of decreasing temperature, it would seem quite possible to exchange the labels under the cuts without seriously affecting the plausibility of the reasoning.

With that part of the final conclusion, already quoted, that locates the sun in close spectral proximity with Arcturus and Capella, no doubt all astronomers will agree.

The process illustrations of the book are not in keeping with its otherwise admirable typographical appearance, and are distinctly inferior to the excellent engravings in the earlier 'Meteoritic Hypothesis.'

Edwin B. Frost.

Astronomy. By Agnes M. Clerke; A. Fowler, A.R.C.S., F.R.A.S.; J. Ellard Gore, F.R.A.S., M.R.I.A. New York, D. Appleton & Co.

It is of supreme importance to a science that the popular writing representing it before the world of culture should be alike a graceful and an accurate exponent of the special subject. Astronomy seems in many instances to have been not too fortunate in the character of the literature promulgated as 'popular astronomy.' The unfortunate experience of this science leads one then the more nervously to examine the credentials of a new recruit, and the more gratefully to welcome into popular astronomical literature a book of the honorable purpose and generally praiseworthy execution of the present volume.

'Astronomy' is divided into four chapters. In the first Miss Clerke submits a concise résumé of the history of astronomy; then follows a chapter on spherical, practical and gravitational astronomy expounded according to simple geometrical considerations by Professor Fowler; the third, also by Miss Clerke, reviews concisely our present knowledge of the solar system; the fourth and last is a concise treatise on the sidereal heavens by Professor Gore.

The prime question naturally suggested by the tripartite authorship is whether a triple responsibility is really necessary in connection with a book whose aim is for the most part popular. A superficial examination would also incline one at once to challenge so ambitious a combination of authors in a book of but 565 pages. Closer examination, however, seems fully to justify the threefold authorship. As a volume of 'The Concise Knowledge Library' it evidently aims both at great conciseness, scientific accuracy and freshness; and hence with the vast domain of astronomical science to be condensed into a moderate-sized volume it was clearly an advantage to have the work thus apportioned among several writers, each facile in the descriptive art and each faithful to the cause of scientific astronomy.

Considering the scope of the facts to be presented and the plan adopted, it would be beyond expectation to find a performance of this sort altogether blameless. Attempt at the required conciseness, coupled with an assignment of special subjects to each author under strict limitations, has seemed to exercise too restraining an influence. Subjects like modern astronomical spectroscopy and celestial photography have, taking the book as a whole, scarcely infused their full inspiration. The extreme brevity of the reference to far-reaching topics like 'tidal evolution' is almost tantalizing. Perhaps the character whose absence one misses most is direct discussion of astronomical methods and results from the standpoint of the active ob-

server. The flavor, while sufficiently literary, lacks a certain essence to be caught up only from the activities of the observatory.

And yet it was expected that a volume counting Miss Clerke, the graceful, accurate and forceful author of 'A Popular History of Astronomy during the Nineteenth Century,' among its sponsors would not be lacking in vital interest. Her contributions to 'Astronomy' have not fallen below her former high standard, except in very few particulars. Especially noteworthy and able are the pages on the history of the achievements of gravitational astronomy of the period immediately succeeding Newton. But by the time the modern stage of spectroscopic astronomy is reached one feels a lack of the former easy swing of her pen, and one also regrets to notice a trace of that peculiar English tendency to ignore foreign scientific achievement. How the judicious pen of Miss Clerke could refrain from setting in artistic relief the grand achievements of a Kirchoff, while it does enthusiastic and just homage to a Huggins, is inexplicable except on grounds of excessive brevity. Truth to say, Miss Clerke has always seemed to repudiate insularity in all of her astronomical writings, and one would not tax her here with anything more than an unconscious bias, in certain particulars, toward her own countrymen, nor indeed generally with anything less than a most fascinating and powerful presentation of the thrilling discoveries and stupendous facts of astronomical science.

Professor Gore's review of the science of the stellar universe gives ample evidence of a determination to bring before the cultured public science fresh from its primal sources. Nearly every page bears evidence of faithful appreciation of the original contributions of astronomers and of a consistent assimilation of the vast mass of material. Although lacking somewhat in that vivacity of style characteristic of Miss Clerke, one is impressed with the conscientious fervour and decisive grasp of Professor Gore's presentation of subjects bristling with numberless suggestive facts and insuperable difficulties.

For Professor Fowler, the accomplished practical astronomer, so favorably known by his successful observational work, was reserved the more or less thankless task of furnishing the more mathematical side of the book. Ever since Laplace, under an unlucky star, rashly attempted to put mathematics into words, in the celebrated *Systême du Monde*, we have become convinced of the necessary inadequateness of ordinary language, and even of ordinary geometry, to the expression of this class of ideas. We cannot, therefore, harshly set forth the weak points which necessarily inhere in an attempt to compress all the marvels of mathematical astronomy into less than two hundred pages of a popular account. Rather would we express the genuine surprise which one experiences in following the author's ingenuity in presenting the difficult geometrical and dynamical conceptions of the astronomer. Most interesting is the complete and accurate though condensed review of the instrumental appliances characteristic of modern astronomy.

It would be a graceless act to close this brief review of a valuable addition to the popular side of astronomy without at once complimenting the American publishers on the fair typography, and condoling with them on the binding of a book of this character in a style bereft of every element of propriety and good taste.

M. B. SNYDER.

Lehrbuch der Entwicklungsgeschichte des Menschen. Von PROFESSOR J. KOLLMANN. Jena, Fischer. 1898. 8vo. Pp. xii + 658.

Embryological literature has been again enriched by a valuable text-book by Professor Kollmann (Basel, Switzerland). As the title indicates, the work deals preeminently with *human* embryology, comparative-embryological facts being adduced only in so far as desirable for a better understanding of corresponding processes in man. The book is furnished with a considerable number of good illustrations, of which a great many are original and entirely new. Preference is given to illustrations taken from 'plastic reconstructions' and so-called 'combined drawings.' Such illustrations are, of course, especially valuable for demonstrating complicated morphological structures which in the single sections of a series are only shown in fragments. It needs, however, to be

mentioned that a few of those plastic figures are somewhat unclear, apparently due to a failure in the execution of the original drawing.

The arrangement of the contents is very convenient. We find in the first part, according to the generally accepted plan, the description of the ovum, maturation, fertilization, cleavage, formation of the germlayers and the fundamental processes in development of the embryonic body, and finally the fœtal membranes. The following chapter contains an exhaustive and very useful account of the growth and external development of the human fœtus, especially during the first two months, together with some data on measurement and the determination of age.

The second part of the book deals with the development of the *special organs*. In arranging this material the author follows the customary method of systematic anatomy, describing first the development of the skeleton and the muscular system, and then going on with that of the intestinal tract, the circulatory apparatus, the nervous system, and finally the skin and the sensory organs. Such an arrangement has many advantages and is obviously adapted especially for medical students. Scattered through the descriptive text we find also some theoretical discussions which are usually marked off from the main text by smaller type. These discussions touch upon questions of special interest for a better appreciation of certain points in human ontogenesis.

In criticising the treatment of the material in Professor Kollmann's text-book one deficiency in the reviewer's opinion seems to be rather serious—that is, the almost absolute neglect of the *histological* differentiation of the tissues in general as well as of the different organs, together with a lack of figures illustrating these processes. These processes are not only of interest for the professional embryologist, but also to a high degree for the medical student, in so far as an adequate knowledge of them is of preeminent importance for a satisfactory understanding of so many physiological and pathological processes of the organs. Hence it seems to the reviewer that in a modern text-book of embryology this important part of development should not be entirely omitted, all the more as recent investigations have thrown more light upon these very complicated processes, and as the field of *cellular* embryology will be more and more cultivated.

These deficiencies, however, in Kollmann's text-book do not interfere with its peculiar excellence, which lies in the exact *anatomical* treatment of the developing organism, together with the elucidation of the text by numerous very instructive illustrations. It is in this especially that the book forms a valuable addition to our embryological literature and deserves to be highly recommended. The different chapters are in general well balanced. The text is concise and clear. Print and reproduction of illustrations are according to the high reputation of the publisher.

ALFRED SCHAPER.

A Primer of Psychology. By EDWARD BRADFORD TITCHENER. New York and London, The Macmillan Co. 1898. Pp. xvi + 314, Price, $1.

As the scientific claims of psychology are more widely recognized, there is an increasing demand for elementary text-books on the subject. Professor Titchener has in mind the difficulties of the beginner, and while there is more science and less glitter in this *Primer* than is common in courses of 'science made easy' it can scarcely fail to interest the novice as well as instruct him. The fundamental concepts are defined with unusual clearness, and every difficult point, as soon as it comes up, is carefully explained, often with the help of illustrations taken from literature or the physical sciencese

The *Primer* is not intended primarily as a course in experimental psychology. The body of the text is rather analytic, although the chief results of experimental research, such as Weber's Law, are given much space. As would be expected in a work by Professor Titchener, the whole treatment of the subject is largely influenced by this branch. Among the many practical exercises found at the end of each chapter, as much in the way of experimental demonstration is included as is practicable for classes with only a limited supply of apparatus at command. When on debated ground the author generally adheres to the theories

most widely accepted among leading psychologists, in preference to his own as expounded elsewhere. For example, he does not attempt to treat the *idea* as a centrally initiated sensation, but allows it a separate place in the analysis.

The arrangement of chapters is certainly logical, though it will probably not appear so to the beginner. The complexity of the subject is not adequately set forth, and (except on the active side) no analysis is given, such as would show the successive degrees of complexity. Thus the pupil is led, first through sensation, feeling and attention, then to perception, idea, emotion and simple action, and finally to memory, thought, sentiment and complex action. Unless his attention be specially called to the matter, he may easily fail to notice the close relation existing between sensation, perception and thought; or that between feeling, emotion and sentiment. A general scheme of these relations would have done much to clear up the subject in the mind of the novice.

The psychology of action is admirably treated, considering the difficulty of the subject. In the prominence given to attention, and the rejection of innervation feelings, Professor Titchener follows the trend of recent discussion. The question of the exact relation of action to consciousness is very properly avoided. On the other hand, impulse, reflex movement, instinctive action, etc., are thoroughly discussed, and this prepares the way for a scientific treatment of selective action and volition in a later chapter. The problem of the freedom of the will, which could scarcely be avoided in a volume of this character, is clearly set forth, and the discussion limited to its psychological aspect.

Perhaps the most noticeable departure from the accepted mode of treatment is found in the chapter on thought. The author makes judgment the primary thought-process. But he apparently limits the term 'judgment' to the first instance in which any particular judgment (as ordinarily defined) is made. "Judging," he says, "is a process of rare occurrence in consciousness. * * * Every generation receives a heritage of judgments from the preceding generations. * * * Even if we wish to judge for ourselves, there are so many past judgments on record in books, and so many others to be had for the asking from our elders, that independent thought is difficult—it follows from all this that propositions like 'The grass is green' are not judgments at all; they do not express results which we have gained laboriously by active attention. That they have the form of judgment may be due either to the fact that they were judgments once, generations ago, or merely to the fact that we cannot utter more than one word at a time, and must, therefore, give the parts of our idea successively. It is only when * * * a total idea is actively divided up that true judgment occurs." (P. 217.) "The 'material' which is worked over and divided up by the attention in judgment" is the "*aggregate idea.*" "A predicate which is common to several judgments is termed a *concept.* * * * The concept is always a word." (Pp. 218–219.) Again, he says: "Thinking is active imagination carried on in words." (P. 213.) Throughout the discussion one feels that too great emphasis is laid on words. Professor Titchener distinguishes sharply between imagination (imaging in kind) and thought and conception (symbolization in words); whereas the general position of psychological text-books would make it appear that the image is closely associated with the word, and accompanies it, as a 'fringe,' at least, in every process. This is not the place to discuss the theory, but it may properly be noted that the author departs here from his own rule that the generally accepted views should be adhered to in an elementary text-book.

The chapter on abnormal psychology includes sleep and dreams, hypnotism and insanity. The chief matters of interest to the beginner in these departments are well summed up; it would be impossible to give more than a summary in twenty pages. In the concluding chapter the province and methods of child psychology, comparative psychology, etc., are pointed out, and the relation of psychology to ethics, logic and pedagogy touched upon. At the end of each chapter throughout the volume are references to passages in other general works where fuller treatment of the topics can be found, while references in the body of the text to physiological and physical works enable

the reader to supplement the necessarily brief discussion of such topics. The apparatus for experimental work is well selected, and gives opportunity for typical demonstrations on almost every problem, with a minimum of cost, while many additional exercises are given, for which no special apparatus is needed.

H. C. WARREN.

SCIENTIFIC JOURNALS.

Journal of Physical Chemistry, May. 'The Transference Number of Hydrogen:' by Douglas McIntosh. An attempt to determine the transference number for hydrogen in different circles by the Helmholtz method, using gas electrodes, but it was found that the method is not applicable to gas cells, probably owing to the solubility of the electrode in the electrolytic solution. 'Single Differences of Potential:' by Hector R. Carveth. The conclusion is drawn that the values given by drop electrodes does not give true single differences of potential. 'Acetonechloroform:' by Frank K. Cameron and H. A. Holly. A study of the camphor-like substance discovered by Willgerodt formed by adding potassium hydroxid to a mixture of acetone and chloroform. From the formula of the substance it would appear to be a simple addition-product, but this is shown not to be the case, and it cannot be resolved into its constituents by direct means. While the substance contains water, it is present not as a hydrate, but apparently in a solid solution. Notes on new books, including an excellent review of the last edition of Mendeléef's Principles of Chemistry; Journal Reviews.

THE *Astrophysical Journal* for May, completing the seventh volume, opens with an article by Professor J. Wilsing, of the Potsdam Astrophysical Observatory, which argues that the results obtained by Messrs. Humphreys and Mohler on the influence of pressure on the wave-length of lines in the spectra of the metals can be explained as an effect of damping of the vibrations to which the emission of light is due. Mr. R. H. Tucker, of the Lick Observatory, follows with an article on 'The Correspondence of the Photographic Durchmusterung with the Visual.' Mr. C. W. Crockett, of the Rensselaer Polytechnic Institute, reviews in two articles the caustic of the right parabolic cylinder and the parabolic mirror. Mr. Frank McClean contributes a paper read before the Royal Society on a comparison of oxygen with the extra lines in the spectra of the helium stars, as also a summary of the spectra of southern stars, and Professor H. A. Rowland and Mr. C. N. Harrison contribute the final article on 'Arc Spectra of Zirconium and Lanthanum.'

THE sixteenth volume of the *Educational Review* commenced with the June number, which includes the following articles: 'Harris' Psychologic Foundations of Education,' by John Dewey: 'Scope and Function of Secondary Education,' by Nicholas Murray Butler; 'Teaching European History in College,' by James H. Robinson; Religious Periods of Child-growth,' by Oscar Chrisman; 'Better Training for Law and Medicine,' by Charles F. Thwing; The Key to Rousseau's Emile,' by Samuel Weir, and 'Attitude of Massachusetts School Authorties toward a Science of Education,' by John G. Thompson.

SOCIETIES AND ACADEMIES.

THE CHEMICAL SOCIETY OF WASHINGTON.

THE regular meeting was held on April 14th.

The first paper of the evening was read by Dr. Hillebrand and was entitled 'The Volumetric Estimation of Vanadium in the Presence of small Amounts of Chromium, with especial Reference to the Analysis of Rocks and Ores.' When chromium has been estimated colorimetrically, as detailed in a previous paper, the vanadium can, in many instances, be estimated without separation from the chromium by the well-known method of titration with $KMnO_4$. With considerable chromium present the error is increased by the difficulty of getting sharp end reaction, due to the color of the chromic salt and to the oxidizability of Cr_2O_3 in hot solutions, but the author shows how to ascertain and apply a proper correction within certain limits.

The method is especially applicable to rocks, iron ores, clays, coals, etc., in which chromium is seldom an important constituent quantitatively.

Tables of numerous test trials on prepared solutions containing from one to 87.5 mg. Cr_2O_3 and from one to 47 mg. V_2O_5 showed errors, with two exceptions, of much less than ½ mg. and establish the method as trustworthy in competent hands.

A further table showed the applicability of the method to ores and rocks to which known amounts of Cr_2O_3 and V_2O_5 had been added. These were fused together with sodium carbonate and nitrate; the silica and alumina were removed from the alkaline extract; phosphorus, chromium and vanadium were thrown down by $Hg_2(NO_3)_2$; the mixed precipitate was ignited; the residue refused with a little sodium carbonate, and in the resulting aqueous extract both chromium and vanadium were estimated, the results being equally as good as those obtained with simple solutions.

The author suggested that the reaction of H_2O_2 on Cr_2O_3 and V_2O_5 in the presence of ether might be utilized to remove the greater part of the chromium prior to titration of the vanadium, since the oxidation product of chromic acid dissolves in the ether, while that of vanadic acid does not; also that the brown color produced in vanadic solutions by H_2O_2 might be made the basis of an exact colorimetric method for the estimation of vanadium.

The next paper was presented by Dr. de Schweinitz and Mr. Marion Dorset and was entitled 'The Mineral Constituents of the Tubercle Bacilli.' The authors, in continuation of their work upon the study of the tubercle bacilli, made a careful analysis of the ash and found a very large percentage of phosphates, calcium, magnesium, potassium and sodium. They pointed out the apparent close connection between the high content of fat and phosphates in the body of the germ and the method of treating tuberculous patients with codliver oil and phosphates. The work is being continued now in the direction of a careful study of the albuminoids of the germ.

Mr. Fireman presented a paper on 'Some Observations on the Centric Benzene Formula and the Aromatic Character.' The centric formula is ascribed to the unreduced ring, while to the partially reduced ring a structure with the double bonds in the ordinary sense is attributed. The transformation of the unreduced into the reduced ring and *vice versa*, as well as the transformation of the ring with the centric structure into the ring with the double bonds and *vice versa*, must be recognized as a characteristic feature of benzene and its derivatives, the aromatic compounds. If this is so, then the centric formula is inapplicable to a ring of either 5, 7 or any odd number of carbon atoms, reduction of such rings being impossible, since the valencies could not be satisfied in case of reduction. Hence the rings of 5 and 7 carbon atoms nearest to benzene in the number of members of the nucleus can not be expected to be endowed with an aromatic character. On the other hand, assuming, as we must, that the tension in the benzene ring, due to the closing of the latter, is small, then a ring of 4 or 8 carbon atoms would similarly have too much tension, which would be incompatible with such a degree of stability as we find in aromatic compounds. It follows, therefore, that from the standpoint of the centric formula and of ring-tension only the benzene ring can be expected to be a carrier of the aromatic character, which is in entire agreement with the facts.

The last paper of the evening was presented by Dr. Stokes, and was entitled 'The Metaphosphimic Acids.' The paper outlined an attempt to explain some of the properties of the meta-phosphimic acids by means of von Baeyer's tension theory. These acids have the general formula $(PNO_2H_2)_2$ and may be regarded as ring compounds. Regarding the rings as polygons, the acids actually studied are as follows, the angle between adjacent sides of the polygon and its difference from 135°, the angle involving the least tension being given:

	Angle between sides.	Difference from 135°.
$P_3N_3O_6H_6$	120°	—15°
$P_4N_4O_8H_8$	135°	0°
$P_5N_5O_{10}H_{10}$	144°	+ 9°
$P_6N_6O_{12}H_{12}$	150°	+15°
$P_7N_7O_{15}H_{16}=(P_7N_7O_{14}H_{14}+H_2O)$	154.3°	+19.3°

Of these acids $P_4N_4O_8H_8$ is vastly more stable than the preceding member and represents a maximum stability with a presumable minimum of tension. $P_5N_5O_{10}H_{20}$ is less stable than $P_4N_4O_8H_8$ but more stable than $P_3N_3O_6H_6$, while

the tension in the ring of $P_7N_7O_{14}H_{14}$ is too great to permit of its existence and it spontaneously takes up water, forming $P_7N_7O_{15}H_{16}$. A further confirmation is found in the fact that the higher members on decomposition in part close again to form the stable ring-acid $P_4N_4O_8H_8$, indicating a disposition to form rings containing P_4N_4. An attempt to test this theory further will be made by endeavoring to prepare diphosphonitrilic chlorid, $P_2N_2Cl_4$. The corresponding meta-phosphimic acid, $P_2N_2O_4H_4$, should have the angle 90°, differing from the angle of least tension, 135°, by 45°. Such an acid should be much less stable than even $P_7N_7O_{14}H_{14}$ and should pass at once into $P_2N_2O_5H_6$.

WILLIAM H. KRUG,
Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, MAY 17.

MR. C. S. BOYER illustrated the structure and geographical distribution of diatoms by a large series of lantern views preparatory to describing the following new species: *Rhabdonema Woolmanianum*, *Biddulphia semicircularis Asburyana*, *B. argus*, *B. interrupta*, *B. keeleyi*, *B. Shulzei* and *B. verrucosa*. The paper, with figures, will be published in the *Proccedings* of the Academy.

MR. T. C. PALMER described and illustrated some of the phenomena of conjugation in *Closterium*. The essential steps are essentially as in *Spirogyra*, in that in both cases the process is at first a putting out of tubes which meet and fuse. But just as *Closterium* differs from *Spirogyra* in its method of cell-division, so it presents peculiarities in manner of formation of the zygospore. The two lobes of the desmid seem to possess a certain degree of individuality, at least at the period of conjugation. These lobes, owing to the peculiar method of growth of the plant, generally differ, at the time of conjugation, in age, and therefore in size, and in the thickness, color and markings of the cell-walls. The contrast between two ends or lobes of a given cell is often very great; and in *C. acerosum*, as a rule, each desmid first separates into two entirely distinct and independent semi-cells, each of which is beautifully rounded off at its blunt end by a new growth of cell-wall. The young semi-cell of each desmid then conjugates with the old semi-cell of the other, and two perfectly distinct zygospores are thus formed. These zygospores and the empty semi-cell cases are held together by a nearly or quite invisible jelly. The 'individuality of the semi-cell,' a tendency toward which has been remarked upon heretofore by Mr. Archer in the case of *C. lineatum*, here becomes practically complete.

In one instance *C. acerosum* formed three zygospores instead of two. One of these was the usual size, made up of the commingled contents of an old and new semi-cell. The other two were about half the size, and consisted each of the unmixed contents of another semi-cell. Of a similar nature is the recently observed discharge, without conjugation, of the contents of a whole cell in *C. lineatum*. The protoplasm, containing small round or ovoid bodies like those in the ordinary zygospore, issued from the ruptured union of the semi-cell cases. It assumed a spherical form. Its development could not be followed further.

The development of the zygospores of *Closterium* is not thoroughly well understood, but the phenomena are probably similar to those of the germination of *Cosmarium*. In addition, however, to this process, another method of reproduction is suspected in *Closterium*, of which the discharge of the cell-contents without conjugation may be one of the stages.

Many of the phases of reproduction in the desmids may be observed to advantage by placing zygospores in life-slides and following the changes that ensue. In such slides large numbers of very minute *Closterium* frequently appear, and these grow perceptibly from day to day, but it is not certain, or even probable, that these arise from the ordinary zygospore.

The following papers were presented for publication in the *Proceedings:*

'Descriptions of five new Phyllostome Bats,' by Gerrit S. Miller, Jr.

'Chitons collected by Dr. Harold Heath at Pacific Grove, near Monterey, Cal.,' by H. A. Pilsbry.

EDWARD J. NOLAN,
Recording Secretary.

Erratum: In the review of Wilder's System of Nomenclature, p. 716, col. 1, line 5, for 'chippocamp' read 'hippocamp.'

SCIENCE

FRIDAY, JUNE 10, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

ON COLOR BLINDNESS.

On the Application of the Flicker Photometer to the Quantitative Study of Color Blindness.

IN the previous number of this JOURNAL, I gave a short account of one of the forms of certain flicker photometers devised by myself, and now will still further illustrate its use by detailing some experiments that were made with it on persons more or less color blind to red. The mode of proceeding was as follows: Plates of deep red and violet-blue glass were placed on opposite sides of the prism and one of the lamps allowed to remain stationary; the blue glass was next to it. On the side of the movable lamp the red glass was placed. In case, then, the patient was more or less blind to red light it would be necessary for him to move up the lamp which furnished the red light nearer to the prism, in order to cause the flicker to disappear, than would be the case in normal vision. This experiment having then been repeated by a person with normal vision, the joint result furnishes the means of measuring the amount of red color blindness, it being, of course, assumed in this procedure that the eyes of the two experimeters are normal for blue light. This determination being finished, I replaced the red glass by green, the blue glass remaining in its old position next to the stationary lamp, and new measurements were made as before by both persons in order to test for green color blindness.

In this manner Mr. T, known to be somewhat color blind to red, was examined, and I found that putting the amount of red light perceived by myself as 100 he perceived only 63.04 per cent. It was also ascertained that his vision was not only defective for red light, but to a less extent for green, he perceiving only 85.5 per cent. of it. A set of control experiments were then made on Mr. T. The blue glass was replaced by the green glass and the red glass was put next to the movable lamp, and for the moment it was assumed that the vision of Mr. T for green light was the same as my own—in other words, green instead of blue light was made the standard, and it was temporarily assumed that both of us were equally affected by green light. The amounts of red perceived by him in two experiments were 71.3 and 70 per cent., as compared with 100 by myself. But as he really perceived only 85.5 per cent. of the green light, to obtain the correct value of his perception of red in these two experiments we must take $\frac{85.5}{100}$ of $70.6 = 60.4$, which differs from the value for the red directly obtained by 2.6 per cent. It may be remarked, in passing, that this case of color blindness was not suspected till revealed by some flicker experiments with colored discs made by myself in Mr. T's presence.

A second case which I examined was of a more pronounced character, and had previously been known to exist. Out of 100 rays of red light perceived by myself, Mr. A. was affected only by 19.44 per cent., violet-blue, as before, being the standard. With the same standard only 86.9 per cent. of the green light was perceived. Taking green as the standard, 22.9 and 23.3 per cent. of red was perceived, and as before, $\frac{86.9}{100}$ of $23.1 = 20$, instead of 19.44, obtained in the direct determination.

The third case of Mr. B. was quite similar to the last, a well-known and pronounced instance of red color-blindness. Violet-blue being taken as the standard, 20.4 per cent. of red was perceived, and 83.8 of green light. Green being made the standard, 25.5 per cent. of red light was perceived, and as before $\frac{83.8}{100}$ of $25.5 = 21.36$, instead of 20.4, as directly obtained when using violet-blue light as the standard.

In these determinations, as in all others of a similar kind which I have superintended, the persons experimented on moved the lamp themselves, without assistance from me, and, owing to the presence of screens, were in complete ignorance of the results they were obtaining. I have been quite surprised to find how quickly persons wholly unused to physical experiments of any kind were able to obtain reliable results with the flicker photometer as now arranged. They needed a little more time, and their probable error was somewhat larger than is the case with an experienced person. Each result given above is obtained from the mean of from ten to fifteen readings registered on the filet of paper connected with the moving lamp. Finally, it is to be remembered that in all of these determinations I have for the time being assumed my own color-vison to be strictly normal, which, now that we have this accurate photometric method, is hardly quite a safe proceeding for any man, or even woman, as some of my unpublished results show.

OGDEN N. ROOD.

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THE OPENING OF THE NEW LABORATORY FOR PHYSICAL CHEMISTRY IN LEIPSIC.

A SHORT time ago an abstract of the address delivered by Nernst at the opening of the new laboratory for physical chemistry at the University of Göttingen was given in SCIENCE. The University in Leipsic has

recently constructed a physical chemical laboratory, which not only equals, but apparently far surpasses, the structure in Göttingen.

As Ostwald points out in the first pages of the pamphlet, 'Das physikalisch-chemische Institut der Universität Leipzig, und die Feier seiner Eröffnung,' Leipsic has taken the lead for a considerable time in physical chemistry. It is true that Kopp worked in Heidelberg as early as 1864, but the work of Kopp belongs distinctly to the older school. The questions raised by him were such as these: What is the relation between the composition of compounds and their physical properties, and what is the relation between the constitution of compounds and their physical properties? Such work, of course, was and is still of great value, but the questions it had to deal with were quite different from those asked by the physical chemist of to-day, who employs also entirely different methods in answering his questions.

Ostwald calls attention to the fact that Kopp was an investigator in his line, rather than a teacher; also to the very poor equipment with which he was provided, the calorimeter with which Kopp's measurements of specific heat were made, being constructed out of a brass match-box. Kopp was invited to Leipsic, but declined the call.

In 1871 Gustav Wiedemann was appointed to the first chair for teaching physical chemistry in Leipsic. On the retirement of Hankel, in 1887, he gave this up, and devoted his entire attention to physics. This left the chair which had been occupied by Wiedemann vacant, and to this Ostwald was called from Riga. He was given the laboratory formerly built for the agricultural chemist Knop, and here all of his work up to the present has been done. The entire laboratory was not given up to physical chemistry, but a part of it was devoted to general elementary chemistry, qualitative and quantitative analysis, and pharmacology. This provision was a wise one, since Ostwald's first semester opened with two students, and the number was reduced to one at the close of the second. The number of students increased until at present it has reached about thirty. In the old laboratory only three small, poorly lighted and modestly equipped rooms were devoted to students in physical chemistry. The difficulties which were being constantly met with are well remembered by everyone who worked with Ostwald during the first ten years of his professorship in Leipsic. The water supply was poor; the method of heating was bad; and, as he himself says, the rooms were too narrow to permit the use of telescope and scale in physical measurements.

When we take into account the conditions under which Ostwald has done his work, and then consider the quantity and quality of the work which has come from his laboratory, we are again reminded, in a forcible manner, of the fact that scientific investigation depends far less upon the equipment than upon the man.

But the 'Leipsic school' of physical chemistry finally completely outgrew its quarters, and a new and elegant laboratory has now been provided. This consists, in reality, of two laboratories, a physical and a chemical. The first story is devoted to the physical, and physical chemical work proper.

One or two points in connection with the equipment of this part deserve special comment. The large research laboratory is provided with one huge thermostat, $370 \times 80 \times 45$ cm. This is provided with thermo-regulators and stirrers, and can be maintained, at a constant temperature, to a hundredth of a degree. This can be used simultaneously, by six or eight students, and is particularly convenient in studying

chemical equilibrium, reaction, velocity, etc. This bath is not used for conductivity measurements, a separate room being provided for that purpose in a quiet part of the building.

Ostwald lays considerable stress upon a weekly meeting of professors, instructors and students, which he holds for the purpose of discussing investigations which are in progress or which have been completed. In this way he thinks the professor will gain a more accurate knowledge of what the student has done that his suggestions will be more adequate to the case, and that the student will acquire a broader view of the problem in his own hands, and a more systematic method of dealing with it.

One further provision in connection with this part of the laboratory is worthy of note. Physical chemistry involves a good deal of theory, and Ostwald has observed, doubtless, as the result of wide experience, that it gives rise to considerable discussion, especially on the part of beginners. Such discussions, even when purely scientific, naturally interfere also with those who are not taking part in them. He has provided a place in which these discussions can be carried on. The corridor is fitted up with black-boards, crayon and sponges. When the controversy becomes warm, the contestants can retire to the corridor, near the door, where it is cool, and here settle their differences in the most approved scientific manner. The gain to be derived to pure science from this provision may be considerable, especially in that men who are really working will not be disturbed by those who are simply talking.

The second story is a well equipped general chemical laboratory and scarcely calls for special comment. They are prepared in the new, as in the old, chemical laboratory, to give a student a general training in chemistry, which is absolutely essential to a subsequent career in physical chemistry.

The new laboratory was opened on January 3, 1898. There were present all the more prominent physical chemists of Germany and a number from outside: Van't Hoff, Arrhenius, Landolt, Beckmann, Waage, Nernst, Le Blanc, Elbs, Walden, Küster, and others. In addition to the physical chemists, there were those whose names are household words in other fields of natural science. Wislicenus, Wiedemann, Pfeffer, Engelmann, Flechsig, Zincke, Dorn, Knorr, and a number of the Leipsic faculty in more remote fields. Ostwald greeted his guests collectively and a number of them individually, and thanked most heartily, those who had made the new laboratory possible, and his assistants who had aided him in equipping it. He expressed the wish that "the spirit of brotherly frankness and the inspiring love of work, which accomplished so much in the old laboratory should remain true to the new. *Without this ethical content our work would be as sounding brass or a tinkling cymbal*," and then gave way to Beckmann.

During the past year a circular letter was sent to all who had worked with Ostwald in the old laboratory, inviting them to contribute to a fund which would be used to secure a bust or portrait of their Teacher. This was to be presented to him at the opening of the new laboratory, as a token of the esteem in which he is held by those who know him best. This met with the heartiest response, and made it possible not only to secure a bust, but also a number of reliefs for the laboratory, of such men as *Scheele, Berthollet, Berzelius, Faraday, Liebig* and *Bunsen*.

Beckmann made a short address, in which he expressed the love and esteem felt for Ostwald by all who have worked under his guidance, and presented a sketch of him from the hand of the Leipsic artist Seffners, which is to be placed in Ostwald's home. This was received with that frank-

ness and humility which are so characteristic of the master; and this now brings us to the most important event of the day—the formal address of Ostwald.

The speaker did not think it desirable to take up a special topic in physical chemistry, because a number of those present were in other fields, and would scarcely have followed him. He, therefore, chose a more general subject, which touches all branches of science, and in which all must be interested—*The problem of time*. This problem is discussed at first philosophically, and then its direct bearing upon physical chemistry is pointed out. Newton regarded time as objective, and distinguished in his *Principia* between absolute and relative time, regarding the latter as being contained in the former. Kant took the opposite view, that time as well as space is subjective. But this idea did not exert its influence on the natural sciences until about the middle of this century. The experimental development of the physiology of sensation brought out the subjective nature of sense impressions so clearly that the importance of Kant's suggestion began to be felt. We must not regard our conception of time as complete, but recognize that it is affected by the physiological conditions of our existence. I regard time as the *most general natural law.* Natural laws have this characteristic: They allow the infinite variety of possibility to be reduced to a special case, or to special cases of reality, and their significance is the greater the more numerous and manifold the phenomena to which the reduction finds application. In this sense time is a natural law. The conception of time expresses relations which are repeated in very widely different phenomena.

Ostwald then proceeds to analyze our conception of time, and finds in it the following four elements :

First, continuity. Time moves on without interruption. During sleep we cannot recognize time, and should be led to conclude that it had been interrupted. But the consideration of the objective world, which has progressed during our sleep, shows that the discontinuity of time is only apparent, and that it has really progressed without interruption.

Second, the linear nature of time. Time is a constant magnitude of such a nature that it is possible to pass from one definite value to another, only *in one way.* This is the same as to designate time as having one dimension.

Third, time never returns to a point or value which has been once passed, and is thus to be distinguished from a line with which it has much in common, since a line can be easily so drawn that it will cut itself.

Fourth, time moves on in one definite order. This is absolute, and a given succession in time cannot be reversed.

After inquiring into the origin of our conception of these four elements into which time has been analyzed, the speaker then considered the bearing of this discussion upon physical chemistry. A very important chapter in physical chemistry is that which deals with the *velocity of reactions.* A solution of this problem would not only complete a chapter of the science, but would throw light upon the most fundamental questions of psychology, and consequently of philosophy.

The chemist Wenzel furnished the foundation, more than a hundred years ago, for the law which obtains for reaction velocity—that under the same conditions, the velocity is proportional to the concentration of the reacting substance. More careful investigation showed that reaction velocity depends upon the nature of the reacting substances, their concentration and temperature, and other conditions which influence it, entirely out of proportion to the apparent magnitude of the

cause which is operating. A very small amount of a foreign substance, which apparently did not enter into the reaction, was found to be capable of increasing the velocity of a reaction to a very great extent. Examples of such reactions have long been known; indeed, the transformation of starch into sugar by boiling with acids, has been known for more than a century. Such action on the part of a foreign substance was termed by Mitscherlich and by Berzelius 'catalytic.' Such effects have recently been classed under the general head of *changes in the reaction velocity.*

Two experiments were then performed illustrating both acceleration and retardation of reaction velocity. If to a dilute solution of potassium iodide an equivalent of potassium bromate and acetic acid is added, free iodine will separate very slowly, and this can be made visible by the presence of a little starch. If a drop of a solution of potassium bichromate or ferrous sulphate is added, the solution becomes blue in a few moments, showing an acceleration in the velocity of the reaction. The bichromate does not act as an oxidizing agent under these conditions, as can be shown by removing the iodine by means of sodium thiosulphate, when the solution will have the yellow color of the unreduced bichromate. Further, ferrous sulphate, which produces the same reaction, is a strong reducing agent.

The retardation of the velocity of reaction was shown as follows: When an acid is added to a dilute solution of sodium thiosulphate the solution becomes cloudy, after a time. The addition of sulphurous acid causes the solution to remain clear for a much longer time. This is probably not catalysis in the strict sense, but the action of mass. Yet there are cases known where the retardation is undoubtedly a catalytic action, but these are less suitable for the purpose of demonstration.

We have, then, in small amounts of catalyzers, a means of increasing or diminishing the velocity of reactions a thousand or a million times. Says Ostwald: "I should like to express my conviction that it is difficult to overestimate the importance of this for organic life."

But what may be the technical significance of catalytic action? To increase the velocity of machines a proportionally larger amount of work must be done. An express train carrying the same weight as a freight, but moving with greater velocity, will consume more coal in traveling the same distance. A galvanic cell will work more economically the smaller the strength of current. Also in the other technical fields *velocity is secured at the expense of energy.*

Only in chemcal processes is this avoided. The addition of a small amount of a catalyzer, which is not used up in the reaction, may enormously increase the velocity of a reaction.

The significance of this for the industries becomes apparent, when we consider how important is the element of time in carrying out technical processes. Could a catalyzer be found for such processes a factory using the same amount of machinery or apparatus could increase its productivity many fold, and thus save interest on capital invested; or a train could greatly increase its velocity with the same consumption of coal.

As a matter of fact, catalyzers have long been used in some of the industries, such as the manufacture of sulphuric acid, dyeing, bleaching, etc. But up to the present this has been purely empirical, and frequently the rôle played by the catalyzer has not been recognized. The intelligent application of catalytic processes to the industries has recently been begun, and this is entirely due to the scientific study of such processes.

"I regard the field of catalytic phenom-

ena as the one in which the next important advances in general chemistry will be made," says Ostwald, who concluded his address thus, the aim of physical chemistry is to discover relations between the different branches of science and, instead of increasing the gap between them, to be an important factor in effecting their union.

In the afternoon a banquet was given to those present and in the evening the students held a 'Kommers.'

Thus was opened the finest laboratory for physical chemistry now in existence, it being the fourth in Germany alone. That of Landolt, in Berlin, is the oldest, while the laboratories of van't Hoff, in Berlin, and Nernst, in Göttingen, have scarcely two years of history. When we consider these facts, and, in addition, the number of places in which physical chemical investigations are in progress, especially in other laboratories in Germany, in France, Russia, Scandinavia, Austria, Japan, Holland, Great Britain, and America, we recognize that this branch of science has taken its place among the more important natural sciences.

And when we consider, further, that work of the character of that which is described as belonging to the 'Leipsic school' has been in progress for only a little more than a decade of years, we are impressed by what has already been accomplished, especially in the way of generalization.

It is to Ostwald that we are indebted for the *Zeitschrift* in which investigations could be published; for the experimental verification of the most important theories, and for the systematic presentation of the facts, in his monumental work —the *Lehrbuch*.

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*WIRELESS TELEGRAPHY.**

DURING the last few months the Solent has been the scene of some interesting experiments in wireless telegraphy. Under the direction of Signor Marconi two stations have been fitted up—one in Bournemouth, just opposite the end of the pier, and the other at Alum Bay, in the Isle of Wight—and between these places, which are $14\frac{1}{2}$ miles apart, regular communication has been maintained without the use of any intervening connecting wires. On occasion an even greater distance has been traversed, for with portable instruments temporarily set up on the cliffs at Swanage it has been found possible to speak with the station at Alum Bay—nearly 18 miles away. But Signor Marconi does not believe that this represents anything like the limits up to which his apparatus can be worked, and he is now making the necessary arrangements for exchanging signals with Cherbourg, a distance of some 60 miles.

The instruments employed at Bournemouth and at Alum Bay are alike in all essential respects. The only outward sign at either place is a tall mast, some 120 feet high, from which depends a metallic conductor. Sometimes this is a simple wire; at others a narrow strip of ordinary wire netting has been tried as affording more electrical capacity, but there does not appear to be any great difference in the results. Inside the stations the first piece of apparatus that catches the eye is an induction coil capable of giving a spark 8 or 10 inches long. This with an appropriate battery and a key to control the current constitutes the sending instrument. The discharge from the coil passes between two brass balls about $1\frac{1}{2}$ inches apart, thus giving rise to electro-magnetic waves which are radiated in all directions. One of the balls is connected with the external conductor already mentioned, the other is put to earth. Some

* From the London *Times*.

experimenters have employed a series of balls immersed in oil to generate the waves, but Marconi's experience is that the simpler arrangement he now employs is just as efficient. The receiving instruments consist of a coherer, a relay and a Morse printer. The coherer, the function of which is to detect the presence of the electric waves that travel through space from the sending station, is a short piece of glass tubing into which are sealed two silver pole-pieces. Between these there is a narrow space containing silver and nickel filings, and the whole is exhausted of air, not because a vacuum directly favors the sensitiveness of the instrument, but to prevent oxidation of the filings, which, of course, impairs their conductivity. These pole-pieces are included in an electrical circuit with the relay and a single cell, and in addition one of them is connected with the external conductor and the other with the earth. Normally the coherer does not conduct a current. But, by virtue of some action which is not yet fully understood, under the influence of an electric wave this condition is altered and a current enabled to pass through the filings between the pole-pieces. The armature of the relay is then attracted and the Morse printer or other suitable receiving instrument brought into action.

Thus the signal is begun, but it has also to be ended if the system is to be of practical use. The conductivity of the coherer does not, as might perhaps be expected at first sight, cease with the cessation of the electric wave that established it, but persists indefinitely so long as the instrument is not disturbed. The least mechanical shock or vibration, however, is sufficient to destroy it and to bring the coherer back to its original non-conducting condition. Hence Marconi provides on the relay circuit an electrical tapper, which by keeping the coherer in a state of constant vibration breaks down its conductivity as soon as it is established. The method of working is therefore as follows: If the operator at Bournemouth wishes to send a message to Alum Bay he connects his outside conductor with his induction coil, at the same time disconnecting it from the coherer. Then by means of the key he puts his coil into operation for long and short periods corresponding to the dashes and dots of the Morse code, thus exciting in the outside conductor groups of electric waves. Some of these fall upon the outside conductor at Alum Bay and convert the coherer there into a conductor; the relay circuit is immediately closed and the Morse instrument begins to print. Of course, during the transmission of one dash the circuit of the coherer is made and broken many times, but the printing instrument treats the quick succession of short currents as a single long one. The rate at which messages are sent in this way is not very great, but it is only fair to say that no efforts have been made to attain speed. The intention has rather been to demonstrate that signals can be sent with accuracy and certainty over a considerable distance without conducting wires.

A number of experiments have also been carried out between Alum Bay and a ship cruising about between the Isle of Wight and Swanage. In every case communication was easily maintained, whether the ship was moving forwards or backwards or swinging round. Nor was the working of the apparatus adversely affected by bad weather. On the contrary, it seemed to act most freely in fog, rain or wind, and was at its work on fine, clear, still days. These facts suggest that an early practical application of wireless telegraphy might be advantageously found in the establishment of communication between the shore and outlying lighthouses and light ships. No really satisfactory way of attaining this desirable end has so far been devised, and seeing that wireless telegraphy can be perfectly well

carried on in the climatic conditions which render other modes of communication difficult, if not impossible, the experiment is surely worth trying.

Other possible applications of this system of telegraphy might be enumerated, but it can scarcely hope to come into general use until one difficulty at least has been overcome, that is, to ensure that a message is received by the person to whom it is sent and by no other. Electric waves are thrown off in all directions from their generator, so that if a man sets up a station all his messages can be read by any one who cares to put up a precisely similar station within the limits to which the waves travel. Two principles may be employed to remove or lessen this inconvenience. Electric waves, like light waves, can be reflected and intercepted; hence a station could prevent the emission of waves in every direction but the one in which lay the station with which it wished to communicate, and thus reduce the possible eavesdroppers to those lying on the line along which the waves were directed. The other principle is that of syntony. Just as one tuning fork will vibrate in sympathy with another provided they are in tune with each other, and not otherwise, so one electric circuit will respond to the oscillations taking place in another, if they are in tune, but will be unaffected if they are not. Two stations therefore cannot telegraph across space to each other unless their apparatus is syntonized; hence by adopting differences of tuning a certain degree of secrecy may be arranged for. It remains to be seen whether the application of these two principles will suffice to provide a solution of the problem.

CURRENT NOTES ON METEOROLOGY.

PHYSIOLOGICAL EFFECTS OF HUMIDITY.

RUBNER and Von Lewaschew have recently been conducting laboratory experiments with a view to determining the effects of different degrees of atmospheric temperature and humidity on the human body (*Archiv. f. Hygiene*, Vol. XXIX). The individual on whom the experiments were made was placed in a closed chamber, into which air of varying known degrees of humidity was admitted. The separate tests lasted from four to eight hours each, and one hour before every test the same breakfast was eaten, while no food or drink was taken during the experiment. The body and the clothing were weighed before and after each trial, so that the amount of moisture given off or absorbed might be known. It was found that at low temperatures (57°–59°) dry air is pleasanter than moist; between 75° and 84° dry air seems cooler than moist when the change is made from one to the other. The last-named temperatures are easily borne if the air is dry. Visible perspiration was first noted at 84.2° and 22% relative humidity. Moist air (96% rel. humid.) made the temperature of 75.2° unbearable for a long time, and the experiment was possible only when there was no muscular movement whatever. At this temperature and humidity there was no considerable perspiration, although thirst was felt. Respiration decreased in dry air and increased in moist air. These experiments are interesting, but they do not give us the actual conditions that prevail in the outside air, as usually experienced by the human body. The movement of the air, which is a very important factor in its effects on the sensible temperature, and the varying amounts of heat lost by conduction, radiation and evaporation, according to the temperature and proximity of surrounding objects, are controls which do not come into play in the laboratory.

ELECTRIC SEARCH LIGHTS AS WEATHER SIGNALS.

THE *Monthly Weather Review* for February contains a note on the use of electric search

lights for the purpose of disseminating weather forecasts. The search light of the U. S. S. *Maine*, which was at the time nearly completed, was, in February, 1895, loaned by the Navy Department to the Weather Bureau for temporary use in Chicago, in experiments designed to test the efficiency of such a means of distributing warnings of coming important weather changes. The light, which had a lens 30 inches in diameter and whose candle power was estimated at about 100,000, was erected on the roof of the Auditorium Building, in Chicago, at an elevation of 270 feet above the level of the street. It was used but once, on February 28, 1895, in giving a warning of a coming cold wave, the light being slowly revolved at the rate of one revolution in five minutes. The night was dark and cloudy, and the signal was seen at a distance of 20 miles. A number of experimental trials were also made, and it was concluded that search lights are not useful for the purpose of disseminating forecasts except under the most favorable circumstances. The compiler of these *Notes* recalls that a number of years ago a similar attempt was made during one summer to flash weather forecasts from the summit of Mt. Washington, in New Hampshire (6,279 feet). This was a private enterprise, in the nature of an advertisement, but was fairly successful as far as the distribution of the forecasts was concerned.

CIVIL SERVICE EXAMINATIONS FOR POSITIONS IN THE WEATHER BUREAU.

It is pleasant to learn, from a note by Professor Abbe in the *Monthly Weather Review* for February, something of the Civil Service Examinations set for candidates for positions in the Weather Bureau. Since 1893 all the positions, except those of Chief and Assistant Chief, have been in the classified service, and therefore a special system of examinations has been arranged. The examination for the position of Observer in the Weather Bureau embraces the following subjects, besides spelling, arithmetic, etc., with the respective weights as given, viz., practical questions in meteorology, 40; an essay on a practical subject in meteorology, 20; geography of the United States, 10, the total number of points being 100.

FALSE DEW.

Aitken's theory that much of what is ordinarily called dew does not come from the water vapor in the air, but from within the plants on which moisture is seen, has received further experimental confirmation at the University of Nebraska, where Professor C. E. Bessey has been carrying on investigations along the lines suggested by Aitken's own observations (*Monthly Weather Review*, March). These studies show that, when the soil is moist and warm, the leaves of plants exude water, which forms in drops on the plants when evaporation from the leaves is checked by the cooling and the consequent increase in the humidity of the air. In cases of unusually active plants, drops may be forced out in dry, warm air. These drops form what is known as 'false dew,' and the process is known as 'guttation.'

NOTES.

From the *Meteorologische Zeitschrift* for April we learn that a bibliography of Italian meteorology is being prepared by the librarian of the Observatory of Moncalieri, near Turin, the list to include all books, pamphlets and articles bearing on meteorology which have been published in Italian.

Among noteworthy recent articles is the following: J. Hann: *Ueber die Reduktion kürzerer Reihen von Niederschlagsmessungen auf die langjährige Reihe einer Nachbarstation.* Met. Zeitschr., Apr., 1898, 121–133.

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CURRENT NOTES ON ANTHROPOLOGY.

LANGUAGES OF HONDURAS.

THE Spanish spoken in Central America has been examined by various writers, notably Ferraz, Berendt and Barbarena. On that which prevails in Honduras a careful study has lately appeared from the pen of Alberto Membreño. It is a well printed volume of 270 pages. Many of the words quoted as peculiar are derived from the native dialects. The author, therefore, has collected, in an appendix of 75 pages, a number of vocabularies and grammatical notices of these idioms. They are seven in number, to wit, the Moreno, Zambo, Sumo, Paya, Jicaque, Lenco and Chorti. He prefaces these with a brief sketch of the present condition of the native tribes in the republic. The ethnographic value of the volume is considerable ('Hondureñismos,' Tegucigalpa, 1897).

THE RUINS OF MEXICO.

IN the *Archiv für Ethnographie* for January there is a description of the ruins of the native city Mixco, in Guatemala, by Dr. Carl Sapper. This was one of the ancient strongholds destroyed by Alvarado in 1525. There has been some uncertainty as to what branch of the great Maya stock inhabited it, but it would appear to have been the chief city of the Pokomams or their near relatives.

In Dr. Sapper's article he introduces a ground plan with elevations of the fortress and town, adding detailed illustrations of several of the ruins, in part restored. While exhibiting some peculiarities of architecture, a general comparison with other remains of the Mayas permits us to class it with the relics of that cultured people. Dr. Sapper remarks that the ruins in northwestern Honduras are purely Mayan in type and in details.

ETHNOGRAPHY OF CUBA.

IN connection with our present contest concerning Cuba it may be worth while to note that a Spanish professor, Dr. Vidal y Careta, printed last year an article of some length in the scientific periodical *La Naturaleza*, No. 8, on the different races who have successively occupied that island or migrated to it within the historic period. He begins by calling the aboriginal stock 'Caribs.' In this point it may be asked whether he is not in a popular error. There appears no evidence that the great Carib stock of South America ever established permanent settlements anywhere in Cuba, although they undoubtedly made predatory incursions against its inhabitants. These certainly belonged to the Arawack stock of the south. In reference to later time Professor Vidal offers less which can be criticised.

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ASTROPHYSICAL NOTES.

FROM the measurement of 234 out of 400 solar photographs taken from 1891 to 1894 by several Russian observers, Stratonoff, of Taschkent, has recently contributed, in the Memoirs of the St. Petersburg Academy, a valuable study of the movements of the solar faculæ. The principal difficulty in such work is in identifying the faculæ on successive days. 103 faculæ were observed on two days, and 5 on three days. The methods of reduction are given in full, and the accuracy of the measures is indicated by the full data for four plates. A list is given of 1062 faculæ for which the angle of daily rotation was determined. In the zone of solar latitude 0° to 10° the angle was found to be 14°.6, and in the zone 30° to 40°, 13°.6, with probable errors less than 0°.1.

The conclusion is reached that the faculæ move at distinctly different angular rates in different solar latitudes, but under a more complicated law than in case of spots. The

period of a solar rotation at the equator as determined from the faculæ is 24.64 days. The order of rapidity of rotation is faculæ, then spots, and last the stratum in which the dark lines are produced which were used by Dunér in his spectroscopic determination of the solar rotation.

The first volume of the Publications of the Zurich Observatory has appeared, aided by a publication fund bequeathed by the late Director, Professor Rudolph Wolf. It contains the observations by Professor Wolfer, now Director, on the solar surface in the years 1887–89. The introduction of photographic methods has not detracted from the value of systematic visual observations of solar phenomena. At Zurich these observations have long been a specialty. Spots, faculæ and prominences are included in the observations, which are given in detail with location in heliographic latitude and longitude, followed by charts graphically indicating the distribution. It seems that the faculæ in the years 1887–89 had a tendency to develop in two special regions of solar longitude nearly diametrically opposite to each other. In a less degree this is shown by the spots, and somewhat by the prominences. The Publication is handsomely printed.

E. B. F.

NOTES ON INORGANIC CHEMISTRY.

Manganese salts in which the metal is trivalent are known, but they are few in number, and all are decomposed by contact with water. In the last *Journal of the Chemical Society*, C. E. Rice describes two double manganic chlorids, $MnCl_3.2NH_4Cl.H_2O$ and $MnCl_3.2KCl.H_2O$, which are stable up to the temperature of 100°. They are formed by dissolving the higher oxids of manganese in fuming hydrochloric acid, immersed in a freezing mixture and adding a solution of ammonium or potassium chlorid. The compounds form minute transparent crystals transmitting ruby-colored light. They dissolve in hydrochloric acid to a dark solution, but are decomposed by water. The analogy of manganese to iron is shown by the fact that the crystals are apparently isomorphous with $FeCl_3.2NH_4Cl.H_2O$ and $FeCl_3.2KCl.H_2O$. The chlorid $MnCl_3$ could not be isolated, and there was no evidence of the formation of any $MnCl_4$.

The last number of the *Chemical News* reprints an article from the *Proceedings* of the Australasian Association for the Advancement of Science, by Professor Liversidge, of the University of Sydney, on the corrosion of aluminum. Two shallow dishes of ordinary sheet aluminum 1 mm. thick were exposed on the laboratory roof for over a year. Rain water caught in the dishes so that they were exposed to the action of any dissolved salts of the atmosphere. The metal soon lost its brilliancy, became gray and rough, and the incrustation did not wash off and could not be rubbed off by a cloth. The dishes increased in weight somewhat less than one per cent. The tarnish was probably due to the formation of a hydrated oxid of aluminum. The tarnish must be comparatively superficial considering the small increase in weight in over a year's exposure. It is, however, clear that the statement frequently found in books that aluminum is unaltered by exposure to the air is not true of the commercial metal, whatever may be the case with the chemically pure metal. In another experiment by Professor Liversidge a sheet of aluminum 1 mm. thick and of 24 square inches' surface was dipped in a solution of salt almost daily for three months, each time being allowed to dry. The plate lost 0.1% in weight, and after washing and rubbing dry 0.3%, showing comparatively little corrosion.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

LORD PLAYFAIR.

BARON LYON PLAYFAIR, the eminent chemist and statesman, died in London on May 29th. We take the following facts regarding his life from the New York *Evening Post:* He was a son of George Playfair, Chief Inspector-General of Bengal Hospitals, and was born at Meerut, Bengal, on May 21, 1819. He was educated at the University of St. Andrew's, and at an early age took an especial interest in chemistry. After studying the science at Glasgow and Giessen he was appointed, in 1843, professor of chemistry in the Royal Institution at Manchester. In the following year he was appointed on the commission constituted to examine into the sanitary condition of the large towns and populous districts of England. He was then appointed chemist to the Museum of Practical Geology. In the great exhibitions of 1851 and 1872 he was Special Commissioner in charge of the Department of Juries. He was chairman of the finance committee of the English Commission at the French exhibition of 1878. Meanwhile, in 1856, he became Inspector-General of Government Museums and Schools of Science, and in the following year was elected President of the Chemical Society of London. He became professor of chemistry, in 1858, at Edinburgh University. In conjunction with Sir Henry de la Beche, he examined, at the desire of the Admiralty, into the suitableness of the coals of the United Kingdom for the purposes of the navy, and into the causes of accidents in mines. He was one of the Royal Commissioners to inquire into the cattle plague on its appearance in England, and a member of the commission which laid the basis for the withdrawal of legislative restrictions on sea fisheries. In 1874 he was President of the Civil Service Inquiry Commission, which produced an elaborate scheme for the reorganization of the British civil service. He sat in Parliament for the Universities of Edinburgh and St. Andrew's from 1868 to 1885, and for Leeds from 1885 to 1892, at which time he was raised to the peerage of the United Kingdom. In the Liberal Ministry of 1873 and 1874 he was Postmaster-General. In Mr. Gladstone's government of 1886 he was Vice-President of the Council. He was a member of many learned societies, and held many British and foreign orders.

THE IMPERIAL INSTITUTE.

THE annual meeting of the governing body of the Imperial Institute, London, was held on May 4th. The Prince of Wales (President of the Institute) presided, and expressed his satisfaction, according to the report in the London *Times*, at the steady progress made in various branches of important work of the Institute, as detailed in the report, and with the reduction of expenditure which had been the result of careful revision of the executive of various branches of the Institute, and incidental expenses. He expressed the hope that members of the governing body would use their best endeavors to promote the proper recognition of the work which the Institute was carrying out by inducing people in different parts of the United Kingdom to become members.

The annual meeting of the Institute was afterwards held under the chairmanship of Lord Herschell. In the annual report, which was read to the meeting by the Hon. Secretary, it was shown, in considerable detail, that the fifth year of the Institute's operations had witnessed a steady expansion, as well as a distinct advance, in their establishment upon a firm footing. It was reported that a public commercial newsroom, very completely equipped with commercial and official publications, had been opened in connection with the collections of the Institute, and that steps were in contemplation for establishing a City branch of the information department of the Institute, to which the public news-room would probably be transferred. The number of public lectures delivered during the winter season had been considerably increased. The exercise of rigid economy, and a careful revision of the details of administration, etc., were reported to have resulted in reductions of expenditure in almost every direction. There had been a considerable falling-off in the number of Fellows during the year, and there had been a somewhat heavy outlay in connection with the Yachting and Fisheries Exhibition. On the other hand, the exhibition of Jubilee presents had furnished a substantial addition to

the year's revenue, besides providing a large contribution to the Prince of Wales's Hospital Fund. The balance sheet presented by the auditors showed a debit balance of £365. Lord Herschell gave an interesting account of the important work which is now being carried out in the Intelligence and Scientific and Technical Departments, and brought before the meeting a number of weighty illustrations of the high appreciation of this work by mercantile houses, manufacturers and colonial authorities. He emphasized the fact that this work was in great part accomplished through the agency of Fellows' subscriptions, and urged that Fellows of the Institute should demonstrate their sympathy with the work by endeavoring to obtain additions to their number. The subject of the criticisms published on the engagement of foreign bands was also dealt with by him, and he concluded an eloquent address by a reference to the fact, now much lost sight of, that the Imperial Institute was founded, erected and established as a monument commemorative of the Queen's Jubilee of 1887.

TESTS OF SEEDS BY THE U. S. DEPARTMENT OF AGRICULTURE.

THE Department of Agriculture has issued a circular which gives a table fixing the standard for purity (freedom from weed seeds) and germination of high-grade seeds and the limit below which seeds are unfit for sale. The circular further says:

The Act of Congress making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1899, under the heading 'Botanical Investigations and Experiments, Division of Botany,' contains the following clause:

The Secretary of Agriculture is hereby authorized to purchase samples of seeds in open market, test the same, and when found not up to standard he may, at his discretion, publish the results of these tests, together with the names of the seedmen by whom the seeds were sold.

The purchase of seeds for the tests authorized under this act will begin July 1, 1898.

The seed must be true to name, and practically free from smut, bunt, ergot, insects or their eggs or larvæ, and the seeds of dodder, wild mustard, wild flax, Russian thistle, Canada thistle (*Carduus arvensis*), cockle, chess (*Bromus secalinus*), quack grass, penny cress, wild oak and the bulblets of wild onion. It must not contain more than one per cent. of other weed seeds.

It will be the aim of the Department of Agriculture in carrying out this law to put a stop to the sale of seed so poor as to make probable a positive injury and loss to the purchaser, thus giving protection on the one hand to the farmer and gardener and on the other hand to the honorable seedsman and seed dealer.

The purchase and testing of the seeds will be carried on under the supervision of the Botanist of the Department, Frederick V. Coville, and in the immediate charge of Gilbert H. Hicks, Assistant.

Seeds showing a test as high as these standards are considered of high grade. Seeds falling five points below the standard in purity, or containing an appreciable amount of the prohibited seeds or more than one per cent. of other weed seeds, or falling twenty points below the maximum percentage in germination are, in general, considered unfit for sale as first class seed, and if sold as such the results of the tests are liable to publication. Furthermore, if seeds sold as of lower grade are found to contain a large amount of weed seeds or show a very low germination, so as to render them practically valueless or seriously injurious, the results of these tests also are liable to publication. It is recognized, however, that in certain cases, as in highly bred varieties or growth and harvest under unfavorable seasonal conditions, seeds may show a germination lower than the normal, and due allowance will be made.

GENERAL.

THE Committee on Education of the Massachusetts House of Representatives has reported a bill appropriating $2,500 in aid of the Boston meeting of the American Association for the Advancement of Science.

MR. GIFFORD PINCHOT has been appointed Chief of the Division of Forestry, Department of Agriculture, to fill the vacancy caused by the resignation of Mr. B. E. Fernow to accept the Directorship of the New York State College of Forestry. Cornell University.

PROFESSOR IRA REMSEN has been elected an honorary member of the Pharmaceutical Society of Great Britain.

DR. W. H. DALL has been elected a Foreign Correspondent of the British Geological Society.

PROFESSOR ROBERT KOCH has returned to Berlin after an absence of a year and a-half, which he has devoted to the study of infectious disease in Africa and India.

PROFESSOR GEORGE RÖRIG, of Königsberg, has been appointed head of the newly established division for agriculture and forestry under the Imperial Bureau of Health, Berlin.

DR. JOHN MURRAY, F.R.S., has been made a K.C.B. as one of Queen Victoria's birthday honors.

THE Royal Academy of Belgium has elected Professor Max Müller to fill the vacant place among the foreign members in the Class of Letters and Moral and Political Sciences.

CAMBRIDGE UNIVERSITY will confer the honorary LL.D. on Sir William Turner, F.R.S., and Mr. F. C. Penrose, F.R.S. The honorary M.A. will be conferred on Mr. Arthur Willey, Balfour student.

MR. C. E. EMERY, the well-known consulting engineer, formerly of the United States Coast and Geodetic Survey, died in Brooklyn, June 2d, at the age of sixty years. He was a Past President of the Society of Electrical Engineers and had received the Telford medal from the British Society of Civil Engineers.

WE regret to record the following deaths among men of science abroad: M. Souillart, professor of astronomy in the University of Lille, correspondent to the Paris Academy for the Section of Astronomy and known especially for his researches on the satellites of Jupiter; Mr. Edward Wilson, curator of the Bristol Museum and the author of valuable papers in geology, on May 21st, at the age of forty-nine years; Mr. W. C. Lucy, an English geologist, on May 11th, at the age of seventy-five years; Dr. C. Herbert Hurst, demonstrator in zoology in the Royal College of Science, Dublin, and the author of valuable contributions to zoology, and Dr. Gustav Reichsritter von Wiedersperg, a prominent Austrian sanitarian, aged fifty-nine.

AT the annual meeting of the National Geographic Society held on May 20th Messrs. Alexander Graham Bell, Henry Gannett, John Hyde, W J McGee, F. H. Newell and A. W. Greely were re-elected members of the Board of Managers. Several amendments were made to the By-laws, one of which reduces the number of Vice-Presidents from six to one. At the meeting of the Board of Managers on June 3d the following officers were elected: President, Alexander Graham Bell; Vice-President, W J McGee; Recording Secretary, F. H. Newell; Corresponding Secretary, Eliza Ruhamah Scidmore; Treasurer, Henry Gannett. The Society has arranged for several summer meetings. A field meeting will take place at Cabin John Bridge, and an indoor meeting in Washington, in connection with the annual meeting of the National Educational Association, which is this year to be held at the National capital. A meeting in Boston has been arranged also, to be held in connection with the meeting of the American Association for the Advancement of Science and the Geological Society of America. The date chosen is Thursday, August 25th.

THE Schweizerische naturforschende Gesellschaft will hold its 81st annual meeting at Berne on July 31st, August 1st, 2d and 3d, under the presidency of Professor Th. Studer. The meeting opens with an assembly on the evening of July 31st, followed by a general meeting and various entertainments on August 1st. August 3d is devoted to an excursion to Grindelwald. The scientific work of the sections is confined to August 2d, and in conjunction with them will meet the Swiss Geological, Botanical and Zoological Societies. Of the thirteen sections six are devoted to physiological, medical and agricultural sciences, which are entirely ignored by the American Association. American men of science would doubtless be repaid by arranging to be present at Berne on the first of August. They can obtain further information from the General Secretary, Professor J. H. Graf, Wyler Str., 10, Berne.

MR. BORCHGREVINK expects to leave London in July for explorations in South Victoria Land on a new ship, 'The Southern Cross,' designed by the builder of the 'Fram.'

Columbia University has sent a zoological expedition consisting of Mr. N. B. Harrington, fellow in zoology, and Mr. Reid Hunt, tutor in physiology, to the Guinea coast, Africa, to study the developmental stages of the Crossopterygian fishes. These are now looked upon as representing more nearly than any other recent fish-like animals the ancestors of the terrestrial vertebrates, and the investigation of their development is expected to throw light on many long disputed problems relating to the origin of the higher animals. The expedition has been made possible by a gift of $1,800 from Mr. Charles H. Senf.

The Yale zoological expedition to Bermuda under the direction of Professor Verrill has recently returned with a large and valuable collection of specimens, illustrating mainly the marine fauna of the island.

Professor C. L. Bristol has left for Bermuda in company with Mr. J. Watson Vail. Professor Bristol will install the laboratory of the New York University, which will be well equipped for the special study of embryology by the time of the arrival of his students, who will sail on June 16th. On this, the second summer expedition, Professor Bristol and his students purpose making a further reconnaissance of the island, with a view to erecting a permanent station. In addition to other researches they will make experiments in submarine photography.

The annual conference of State and Provincial Boards of Health of North America will meet at Detroit on August 11th and 12th.

The Bucks County Natural History Association, Pennsylvania, held its annual meeting on June 2d. An address upon the work of the Association was made by Mr. Nathaniel Richardson, the President, and the program included a paper on petroleum by Professor Hart, of Lafayette College.

The fifth International Congress of Hydrology, Climatology and Geology will be opened at Liège on September 25th next.

The bill appropriating $10,000 for the extermination of the brown-tail moth in Massachusetts has been passed, with the important exception that it was amended by striking out the appropriation of $10,000 and providing that all expense connected with the work should come out of the appropriation for exterminating the gypsy moth. The Board of Agriculture is given charge of the work.

The United States Civil Service Commission announces that on June 27, 1898, examination may be taken for the grade of Nautical Expert, Navy Department, Hydrographic Office. There is at present a vacancy in this grade at the Hydrographic Office at Washington at a salary of $1,000 per annum and another at the branch Hydrographic Office, New York City at a salary of $1,400, which it is desired to fill. The examination will consist of the following named subjects, which will be weighted as follows:

Letter-writing,	1
Pure mathematics,	3
Physical geography,	2
Nautical definitions,	1
Navigation,	2
	10

The first meeting of the State Trustees of Scenic and Historic Places and Objects, under their new corporate name of 'The Society for the Preservation of Scenic and Historic Places and Objects,' was held in New York on May 31st. The following governing board of trustees was elected; Andrew H. Green, Frederick W. Devoe, Samuel Parsons, Jr., Henry E. Howland, Walter S. Logan, Edward P. Hatch and Edward Hagaman Hall, of New York, and Charles S. Francis, of Troy. Mr. Green was elected President, Mr. Francis Vice-President, Mr. Hatch Treasurer, and Mr. Hall Secretary.

The Council of the British Medical Association are prepared to receive applications for grants in aid of researches for the advancement of medicine and the allied sciences. Applications must be made to the General Secretary, at the office of the Association, 429 Strand, W. C., and must include details of a precise character and objects of the research which is proposed. The Council are also prepared to receive application for one of the three Research Scholarships, which is of the value of £150 per annum, tenable for one year, and subject to renewal by the Council for another year.

THE managers of the Pennsylvania Hospital in Philadelphia have taken steps to add to the institution a clinical laboratory, the funds being provided by a bequest of $50,000 by the late Josephine M. Ayer, of Philadelphia, supplemented by a gift of $25,000 from her son, Fred. F. Ayer.

UNIVERSITY AND EDUCATIONAL NEWS.

THE New York University Medical College and the Bellevue Medical College will be consolidated under the name 'The University and the Bellevue Hospital Medical College.' It will be remembered that the negotiations for this union failed a year ago at the last moment, but the resignation of a portion of the faculty of the New York University Medical College to form a new school under the auspices of Cornell University has now led to the consolidation.

THE Trustees of Colby University have made a contract for the construction of a chemical laboratory to be built of stone and brick and to cost $30,000.

THE will of the late Felix R. Bonnet, of Pittsburg, Pa., provides that, upon the death of his widow, $300,000 shall go to the Western Pennsylvania University for the endowment of scholarships.

PRESIDENT F. P. GRAVES, of the University of Wyoming, has been elected President of the University of Washington.

THE following promotions and appointments have been made by the corporation of Yale University: Assistant Professor Sneath was promoted to a full professorship of philosophy in the College; Dr. Philip E. Browning, promoted from an instructorship to an assistant professorship in chemistry; Dr. E. W. Scripture was given the title of director of the psychological laboratory; E. M. Weier, B.A., 1895, was appointed assistant in the same laboratory; George Grant McCurdy, B.A., Harvard, 1893, was appointed to a new instructorship in prehistoric anthropology in the Graduate School; H. E. Gregory, B.A., 1896, instructor in physical geography.

THE University of Dublin has elected to the chair of mental and moral philosophy Mr. Swift Paine Johnston, who is said to be an American citizen.

MR. H. YALE OLDHAM has been appointed reader in geography in Cambridge University.

DISCUSSION AND CORRESPONDENCE.

'A PRECISE CRITERION OF SPECIES.'

TO THE EDITOR OF SCIENCE: In the issue of this JOURNAL for May 20, 1898 (N. S. vii., No. 177) is a joint contribution, under the above title, by Messrs. C. B. Davenport and J. W. Blankinship, in which Mr. Davenport, under the subheading '*A*. The General Method,' says: "What is needed is a method of precisely defining the degree of isolation and the degree of divergence necessary for distinct species." To establish such a method, and to define 'the degree of isolation and the degree of divergence necessary for distinct species,' is the grand task here undertaken—and accomplished, to the satisfaction apparently of, at least, the author of the paper; and his diagrams of curves and his mathematical formulæ are very interesting and very suggestive, so far as they go. But the conclusions based thereon, and the methods by which they are reached, display an extraordinary lack of practical experience with the actual conditions of the problem in hand. No one duly appreciating the conditions to be met would ever undertake to formulate a 'method' on such imperfect data as he has employed for the 'Determination of the Line between Species and Varieties,' since their utter insufficiency is obvious, one would suppose, to any one at all experienced in this field of research.

"The question arises," says Mr. Davenport, "whether it would not be necessary to draw curves for many characters." He answers: "Practically it will not be necessary, for confluent species are usually separated chiefly by one most distinctive character." Unfortunately, this is not the case, but by a combination of slight differences along a number of distinct lines. But suppose it were as Mr. Davenport assumes, and the most distinctive character was one of color, involving not only the prevailing tint, but coincidently variations in

the markings of particular parts or areas. Generally, it is not only this, but color differences combined with variations either in general size or in the size of special parts or organs, in which the variations of different parts are sometimes in opposite directions. If the author had worked directly from large series of specimens, instead of taking data tabulated by others relating to the single character of size, it is pretty safe to say that the paper here under notice would not have been written.

In the case of *Zapus* there is no reason for doubt in respect to the status of the two forms. They present as clear and well pronounced evidence of specific distinctness as could well be looked for between congeneric forms. In the case of *Scalops* the curves of differentiation are based on the single character of general size, the length of the skull being taken as the basis. Other characters of perhaps equal or even greater importance, as the increase in the size of the teeth with decrease in skull length or in general size, the relative length of the tail and marked differences in color are ignored, perhaps because the differences in these features are not easily reducible to 'quantitative expressions.' But taking size alone, what kind of a 'method' is it that attempts to determine quantitative difference, say between *Scalops aquaticus* from Massachusetts, Connecticut and New York and *Scalops machrinus* from Minnesota, Illinois and Iowa by taking in the first case a few specimens at irregular and infrequent intervals from Cape Cod to Charleston, S. C., and in the other in a similar way from Minnesota to Louisiana? In either case the difference in size is greater between specimens from the northern and the southern points in either series than between specimens from corresponding points in latitude between *S. aquaticus* and *S. machrinus!* Mr. Davenport's Fig. 8 thus shows nothing of any value whatever. The quantitative study of variation is a problem of great interest and importance, but this is not the way to go about it. The ideal way, and one which would be profitable in results, would be to take a sufficiently large series of adult specimens, say in the case of *Scalops* of not less than 20 to 50 from judiciously selected localities not more than 100 miles apart, along at least two lines, the one meridianal, the other on a parallel of latitude (due regard in each case being had for differences of elevation), and subject each available character to quantitative analysis. Were this done on a series of such intersecting lines extending throughout the ranges of all the forms of a genus the results might then be expressed in curves that would reflect actual facts and throw important light on the status and real relationships of all the forms involved. It might be well worth doing, at least in the case of a few groups, for the general bearing such results would have on the problems of evolution; but the millenium of a precise knowledge of species and subspecies for any class of animals—say of North American mammals—will not arrive in our day if we must wait for the production of that delightful result by the process of quantitative determination of character variation. The work and expense involved is too great, and long before final results would be available the methods now in vogue of studying comparatively large series from as many localities as possible will probably have already covered and decided most of the points such an elaborate system might be properly expected to establish.

J. A. Allen.

A NECESSARY CORRECTION.

To the Editor of Science: In an article claiming to be a review of 'The Living Substance' (Supplement to *Journal of Morphology*), which appeared in *Nature* recently, the reviewer, F. A. D., says: "*The authoress of this wordy treatise informs us (p. 173) that she started from a neutral position with regard to Bütschli's vesicular theory, or even with a bias against it. Now, however, having become the most ardent of converts, she proceeds, with the proverbial zeal of a proselyte, to carry the original doctrine to extremes. Not content with proclaiming the existence of foams undreamt of by Bütschli—'wheels within wheels' ad infinitum—she utters what amounts to a denunciation of all previous statements of biological fact and theory as misleading and inadequate, and urges in effect that the whole science of life needs recasting from the new point of view.*"

Now, Bütschli's famous vesicular theory of protoplasm argues for a physico-chemical interpretation of protoplasmic activities. Believing that he had discovered a fundamental vesicular structure, Bütschli held that amœboid movements, the phenomena of cell division, and even contractility, may be interpreted as results of osmotic interchanges, surface tensions and extension currents amongst the lifeless lamellæ of this structure. He admits, however, "I find myself unable * * to apply the same physical explanation to the finer formations, such as the free filose formations * *." Further, that "the morphological method, so fruitful in research amongst multicellular organisms, fails in our research into the essential nature of the elementary organism—the cell."

Compare the following from 'The Living Substance.'

(1) "The vital phenomena of protoplasm were seen to be not so much manifestations of the vesicular form of the substance, as upon, or through, this," p. 67. (2) "The co-existence of a stable and perfect structure of Bütschli, with a host of metamorphosing activities of the substance as such ; this forms one of the strongest reasons I would urge for preferring optical research upon the living material," p. 68. (3) "It is the free filose formations, not amœboid flow, which I find to be most universal, most characteristic and most fundamental in the living substance," p. 78. (4) "It is then, not that compound of cells whose multiplication we have watched with such breathless interest that is the true organism, but the continuous substance, by whose local deposits of specific materials these cells and their nuclear machinery are built up * * * . And within the organism's limits, the protoplastic substance as such retains, one must now believe, all those protoplastic powers which are seen in free Heliozoa—all those tactile and selective and sensitively irritable, and contractile, functions that protoplasm exhibits when placed externally to cells, areas, or masses. On this protoplastic substance the race habit depends, and in it are rooted all other habits of organisms," p. 170. (5) "Organs no longer appear as compounds of certain different sorts of cells, but as a complex of minute substance organs," p. 151. (6) "The organism as we have known it, is secondary, incidental to the life-history of the protoplastic, continuous substance of the living being ; is result, rather than cause, of substance habit," p. 171. (7) "We are not denied an ultimate return to purely physical interpretations * * * but we are bidden for the time to a physiological standpoint as more immediately fruitful," p. 119. Under Areal Differentiation, Striation and Activities, hundreds of radically new facts prove that any present application of physico-chemical explanations, by means of vesicular structure, to either contractility or cell division is not possible.

The rest of F. A. D's article bears out the beginning, is a crescendo of similar blunders and guesses—personal in tone, hysteric in timbre, and unsupported by a single quotation ; but in view of the cardinal absurdity of wholly ignoring the text of the book 'criticised,' one's sense of humor vetoes further analysis.

G. F. ANDREWS.

SCIENTIFIC LITERATURE.

La face de la terre (*Das Anlitz der Erde*). EDOUARD SUESS. Translated from the German with the approval of the author and annotated under the direction of EMM. DE MARGERIE, with a preface by PROFESSOR MARCEL BERTRAND. Paris, Armand Colin et Cie. 1897. Vol. I. Pp. 835. With two maps in colors and 122 figures.

The first part of *Das Anlitz der Erde* appeared in 1895. The author set himself the task of marshalling the movements of the earth's crust into a system. The work gives the result of his studies of mountain systems and of the adjacent plateaus and plains. From its scope and the radical views of the author, the treatise takes a place in geological literature with the famous Notices sur les systems des montagnes of De Beaumont, published in 1852.

De Beaumont gave us, perhaps, the first clear statement of the contraction hypothesis in its relation to mountain building. In his treatise on mountains he sought to establish the principle that mountain chains of the same age are parallel to the same great circle. In attempting to defend his thesis, De Beaumont made

use of his own personal knowledge and when that gave out resorted to the bibliographic method of research. Suess had no small share in the recognition of the wonderful overthrust phenomena of the Alps. He thus came into possession of knowledge of earth movements which were still unperceived, except by a few individuals, in the time when De Beaumont wrote of the 'pentagonal network.' Following up his own investigations in the field about the eastern Mediterranean with a study of the literature, Suess worked out a system of movements in the earth's crust, which is, to say the least, possessed of the merit of novelty.

Suess has arranged his facts and the interpretations which he has placed upon them in a classification of crustal movements. He recognizes one group of movements which result from tangential pressure. In this category he places the overthrusts, or essentially horizontal movements on horizontal surfaces, and 'decrochements,' or horizontal displacements along vertical planes. These movements he finds taking place in regions of folded rocks, such as the great mountain chains of Europe and Asia.

Suess makes a second group of dislocations, including effects due, as he thinks, solely to gravity. He states that everything in this group of dislocations behaves as if the parts of the earth's crust affected by them "fell under the influence of their own weight into large open cavities below, or as if the surface of the globe sank into a soft base yielding under pressure." It is in respect to this view that the conception of crustal deformation entertained by Suess is in most striking contrast to the generally received interpretation of faults coming in his second group. Where several fault blocks divide, for instance, a table-land, into masses standing at different levels with reference to each other, Suess postulates an invariable downward movement for the blocks which stand relatively low. He does not suppose that uplift has taken place in the case of the blocks which stand relatively high. To account for this falling-in of the crust, Suess postulates a radial force as one of the components of the force of contraction.

The present volume consists of a number of essays in which, in one way or another, the effects of these several dislocations of the crust are shown and traced with great detail. The opening chapter is a most entertaining discussion of the Deluge, a subject which geologists have, perhaps wisely, neglected since the time of that masterful romancer, Burnet, and his school. The story of the Deluge is told in the light of the Chaldean account of Genesis. An abstract of this chapter has already been presented to the readers of SCIENCE by Professor Emerson (see Vol. IV., 1896. pp. 335–344). Suffice it to state here that Suess finds an explanation of the disaster in the valley of the Euphrates in the conjunction of an earthquake and a cyclone. Many circumstances, as, for instance, the boat of Xithrusos being carried inland instead of out to sea, go to show, he thinks, the effects of a great marine invasion. He concludes that the "traditions of other people do not authorize us in any manner to suppose that the Deluge passed the limits of the lower basin of the Euphrates and of the Tigris, and still less to state that it extended over the whole earth." The legend appears to have been introduced by our author to show that some of the dislocations and falling-in of fault blocks in that part of Eurasia took place within the memory of man.

The chapter on earthquakes is an attempt to establish the existence of lines of fracture and earth movement, and incidentally to show that these movements are not of an elevatory kind. Admitting that there are earthquakes which have a local point of origin, there are other earthquakes, he states, which cannot be traced to one small place, but are due to the simultaneous movement of an extended portion of the earth's surface. He selects for discussion four areas in which shocks are held to be of a different character. These may be briefly summarized: 1st. The Alps of the Northeast, without volcanoes. In this region, near Vienna, shocks have been propagated at right angles to the chains of mountains, indicating horizontal movements on cross-fractures ('decrochements' or 'Blatten.') 2d. Southern Italy, with volcanoes, but these without alignment. Here there is a circular line of areas of earthquake shock passing from Calabria into Sicily and having the Lipari Isles at center. It is thought that within the area limited by the

periphery thus marked out the earth's crust sank, for instance in 1783, in the form of a basin, and at the same time there were developed radial cracks converging in the Lipari Isles. Near the center these lines are beset with points of eruption. The perennial and isolated volcanoes, such as Ætna, he thinks, are located on the crossing of these radial fractures with the peripheral line of faulting. 3rd. Central America, where earthquakes are frequent though not well studied, but where the disposition of volcanoes is held to indicate great fractures. These volcanoes may be placed in two groups, or alignments, which join at an obtuse angle in the Bay of Fonseca, between San Salvador and Nicaragua. The shifting of vents here is towards the Pacific Ocean. Suess thinks the fractures have opened downwards and that this region is sinking. 4th. The western coast of South America, made classical by the writings of Darwin. Darwin has been for half a century the authority for the belief that, during the earthquake of 1835, the western coast of South America was elevated at least nine feet. Suess's thesis leads him to attack Darwin's conclusions. Our author quotes contemporaneous records, known to Darwin but set aside in his time, to show that no elevation took place. Much of the testimony is of a purely negative character. Modern observers are cited to show no existing evidence of the supposed change of level, and Lyell's admission that the coast appears to have subsided to near its former level is used to make it appear doubtful if there was any uplift whatever. It is suggested that the throwing up of jetsam by a seaquake wave would give all the appearances of an elevated beach which Fitz Roy and Darwin describe. It is further pointed out that Darwin mistook a kitchen-midden for an elevated beach and may have been mistaken in his observations concerning the elevated beaches of 1835. The statement by Darwin that barnacles were found attached to the rocks at the elevation claimed is not considered by Suess. Altogether this section of the work does not convince one that Darwin was mistaken in his belief that the coast was elevated nine feet, however much it may have sunk since 1835.

Space does not permit a reference to all the questions which Suess discusses. Concerning deep-seated masses of igneous rocks, such as laccolites, it is only necessary to remark that he regards these as coming into the crust under the influence of tangential pressures or as filling cavities produced by the rupture of the crust in the direction of one of its radii.

In the second part of this volume the author describes the general geology of the country in front (north) of and in the rear (south) of the Alps, defining the foreland as the area towards which the mountain-built rocks have been pushed. He shows that the folded strata of the Carpathians have advanced upon the rocks of the 'platform of Russia.' Farther west, in Franconia and Swabia, the country is broken up into fault-blocks, the parts which stand up forming 'horsts.' In the case of the Ries and and Höhgau circular areas of depressed rocks occur as if the crust had there been punched downward. Such areas are supposed to be bounded by several lines of faulting rather than by a single circular fault.

The direction of the Alpine system is found to be that of a flattened down S, including the Carpathians, the Alps, the Apennines, Sicily, the Atlas range of northern Africa, the Pillars of Hercules and the mountains of the south coast of Spain. The plateau of Bohemia, the region of the Adriatic and the western Mediterranean are held to be comparable areas characterized by depression. Special chapters are devoted to the evidence of their structural likeness. So much of this evidence is found in the region of the Mediterranean Sea that an essay, one of the most instructive in the work, is devoted to the geological history of this water-body. Its several stages of enlargement and curtailment of area, and the changes of level it has undergone, with its variations in salinity, are fully treated, together with a synopsis of the several groups of deposits marking its development.

One of the astonishing results of the author's studies is his conclusion that in the second stage of the Mediterranean its shore-line was from 440 to 450 meters above the present sea-level. This stage corresponds in age with the Upper Miocene. The reason Suess assigns for this conclusion is apparently found in the statement (p. 412),

concerning certain beds of this stage, that "between Brünn and Olmutz (in Moravia) there exists a large number of these outliers in the form of isolated buttes, of which the upper plateau, formed of limestone with Lithothamnium, attains very uniformly the altitude of from 350 to 355 meters. Nevertheless at Ruditz, not far from Brünn, this formation occurs as high up as 435 meters, and at an elevation of 429 meters at Abtsdorf, towards the bottom of the great gulf of Bohemia. If we assume, as Suess does, that broad sheets of flat strata cannot have been elevated to their position, they must have been deposited at that or a higher level. Hence, the adjacent lower lying deposits of the same stage, together with the sea-level, have been depressed.

Two chapters are devoted to the great desert plateau of the Sahara and to the fragments of the Indian continent, or Gondwana-land. The lands of these areas are held to be the oldest in the eastern hemisphere. The geological knowledge concerning this district is fairly well summarized, the faults and evidences of change of level by displacement being particularly set forth. In the sequel of this work Suess promises to consider whether the sinking of continents so vast as the lost areas of Gondwana-land has been able to produce a general lowering of the shore-lines and so determine the emergence of plateaus like that of Sahara and Arabia.

Two long chapters are devoted to a description of the mountain chains of India and Central Asia, presenting a good summary of the geology of these regions. North and South America then come in for discussion and comparison with typical Alpine areas. Concerning the earthquakes of the South American coast, Suess holds them to be 'the index of some great tectonic phenomenon of the present epoch, the nature of which is unknown.'

Closing the first volume is a chapter on The Continents. Our author, admitting the difficulty which arises in deciding upon characters which should be accepted in defining the age of a continent, thinks it best to fix its birth 'from the time when the sea has definitely abandoned the large depressions in its area.' In this light North America is held to be no older than the Laramie. In this same point of view, Gondwana-land is much older than America.

Many interesting questions, which the above outline of Suess's views will raise in the mind of the physical geologist, will best be deferred for discussion in connection with the promised second volume of the work, in which it is understood they are to be treated by the author himself.

The first volume is accompanied by a list of contents and is well printed. The pages bristle with footnotes and bibliographic references, the larger part of which are due to the comprehensive grasp of the current literature of geology which M. De Margerie has more than once displayed. As a key to the geology of a large part of the globe the book is invaluable on this account alone. The illustrations are few in number, but good. Many points in the distribution of geological formations on which the argument so often depends might be made clearer to a large class of students by the addition of a few more maps. An atlas as detailed as Stieler's Hand-Atlas is really necessary for following some of the descriptions in an intelligent way. While one closes the book without being convinced that the author's point of view and his interpretation of certain fields are necessarily the only or the right ones, he does so with a feeling of renewed interest in the geology of large areas and in the great physical problems of the earth. Every advanced geological student should read the book for information, for suggestion, for a broadening of his view and to see how a master in the art of writing marshals facts from one of the widest and most varied fields of natural science.

J. B. WOODWORTH.

A Classified Catalogue, with Localities, of the Land Shells of America, North of Mexico. By H. A. PILSBRY. Philadelphia, April, 1898. Pp. 35.

The appearance of a new catalogue of North American land mollusca is a matter of interest, not merely to malacologists, but to all students of geographical distribution. Mainly through the efforts of Mr. Pilsbry, our snails have been newly classified in recent years, more nearly in accordance with their relationships than heretofore. At the same time, the genera have been divided into subgenera and sections, while

numerous new species and subspecies have been described, so that in all respects the new list is very different from its predecessors.

Looking through the list, from the standpoint of the student of geographical distribution, we notice the following points as worthy of comment:

1. Notwithstanding our proximity to the Greater Antilles, of which we have an especially lively realization at the present time, we get scarcely more than a tinge of their wonderful snail fauna, even in Florida. Thus the list includes but two Cyclostomatidæ, both West Indian species, and these confined to the hot part of Florida. This seems really remarkable, when we remember the innumerable species of this family in Cuba, and remember, further, that they are operculate and might, therefore, be supposed to resist the sea water and readily travel on floating trees.

2. The northward distribution of Mexican types is interesting. *Bulimulus* has kept to the lower levels, as is its wont, but has got as far (*B. dealbatus*) as North Carolina, Kentucky and Alabama. *Holospira*, on the other hand, occupies mainly the tableland, and even the tops of the mountains in southern New Mexico, but not north of the middle of that Territory. It is a Southern type, extending into the upper Sonoran zone, like the bee-genera *Centris*, *Exomalopsis*, etc.

3. The distribution of our typically American snails, *Polygyra* (sens. lat.), is especially interesting. They are, of course, in great force in the eastern United States, from north to south, and well into Canada. A section of them inhabits the Pacific coast region, and goes inland, like certain slugs of the same region, to northern Idaho. In Wyoming and Colorado the genus is totally lacking, but coming down to New Mexico we find a southern section of it appearing, but only at high elevations. This last-mentioned section extends down to the tableland of Mexico, and even to the lowest levels on the eastern side. It seems possible that *Polygyra* once inhabited the whole Rocky Mountain region, but that during glacial times was exterminated as far south as the ice went, which must have been about to its present northern limit. It could not well live on the low, dry plains, but survived on the moister, forest-clad mountains southward, where it can be found to this day. It may be, therefore, that *Polygyra* will yet be found fossil in Colorado and Wyoming.

4. In the Limacidæ (the ordinary slugs) six species are listed; but it is not stated, as it should be, that three have been introduced by man. The remaining three are all very close, indeed, to European forms; indeed, it has been held on very good authority that *Agriolimax campestris* is not a species distinct from the European *A. lævis;* while I have more than once examined the Pacific coast *Amalia hewstoni* both internally and externally, and cannot see that it is anything but *A. gagates.* Yet there is no doubt that *Ag. campestris* and *Am. hewstoni* are native with us; the former is common almost all over the country. It is a very striking thing that we should have so few Limacidæ, and these so little peculiar, when Europe is so rich in large and beautiful types of this family.

5. The Arionidæ, another family of slugs, is well represented in Europe; but, apart from an introduced species, totally wanting in this country except in the Pacific coast region, extending to northern Idaho, as above mentioned. Here, however, it extends from British Columbia to southern California, and has at least fourteen species, belonging to seven distinct genera, all endemic!

Many other interesting facts can be gleaned from a perusal of the list, but it would take too much space to enumerate them. Of adverse criticisms we have few to make, and these relate to minor points of no general interest. The subfamily Arioninæ should not be credited to Pilsbry, as it was indicated and named by W. G. Binney in 1864, and is only now restricted by Pilsbry. The proper citation would be Arioninæ (W. G. Binn.) Pilsbry. *Veronicella* should unquestionably be used in place of *Vaginulus.* Other such matters could be mentioned, but we may leave the subject with the wish that so useful a list might be compiled for many another division of our fauna, at least for the fresh-water mollusca, which have not been catalogued properly in recent times.

T. D. A. Cockerell.

Mesilla Park, N. M., May 5, 1898.

Bibliographia geologica répertoire des travaux concernant les sciences géologiques dressé d'après la classification décimale et formant la partie (549–571) *de la Bibliographia Universalis.* Par MICHEL MOURLON, Directeur du Service géologique de Belgique avec la collaboration de G. SIMOENS, Docteur en sciences minérales, attaché au Service. Bruxelles, 1898.

This publication is accompanied by two pamphlets, 'Liste des périodiques compulsés pour l'élaboration de la bibliographia geologica dressé d'aprés la classification décimale par le Service géologique de Belgique,' and 'La classification décimale de Melvil Dewey appliquée aux sciences géologiques pour l'élaboration de la bibliographia geologica par le Service géologique de Belgique.'

Bibliographic work of the science of geology has heretofore been of a very fragmentary character and limited both geologically and geographically. But now we have here an attempt to compile for a definite period a universal bibliography of geologic literature. Bibliographic works have always been welcomed by geologists, and this one will surely receive its full quota of approval. The difficulties which attend the labor of preparing bibliographies of books written in languages with which one is more or less unfamiliar can hardly be realized. The various monographs, bulletins, proceedings, transactions, journals, memoirs, etc., published in many different cities and under the auspices of various government organizations and societies are full of pitfalls to one in a distant country who is not personally familiar with their methods of procedure, times of publication, etc. The various omissions in this work which are due to such causes have been passed over. Attention is here directed to the method of arranging the bibliographic matter and also to the scheme of indexing, which is somewhat new in its use for this purpose, and to which there appear to be certain fundamental objections which are inherent in the plan itself.

In this bibliography there is no alphabetic arrangement by authors' names, not even under the various subheadings. Apparently the papers are arranged under subheadings according to the index number—that is, papers that belong under one subheading and have the index number 549.1 are grouped together; then 549.2 follows, and so on. Hence if you wish to find a particular paper you must know the subdivision of geology and index number under which it would be listed before you could find the reference to the proper publication. The arrangement is particularly unfortunate, and it is quite evident that in any bibliographic publication there should be one alphabetic arrangement by authors' names.

The classification of any branch of science is something that is always subject to modification, as our knowledge increases and ideas change. Such a classification should not only be elastic, but able to be rearranged to suit the ideas and needs of the individual without impairing its usefulness as a whole. The subject classification adopted for this portion of the *Bibliographia Universalis* will hardly meet with general approbation. The character and occurrence of metaliferous deposits can be classified under mineralogy only on the widest acceptation of the term, and is a rule not applicable to a minute classification. Certain subdivisions of stratigraphy under the heading geology are local, and are recognized by but few geologists, and only in restricted areas.

The decimal system of classification employed in this bibliography is used for putting books in order on the shelves of libraries, and is a quick method of finding them. Its value for such a purpose is no criterion by which to judge of its usefulness in a detailed classification of our knowledge of various subjects. Such an arbitrary system might be useful to the individual formulating it, but does not necessarily fulfill the requirements of a number of individuals.

The numerical system is open to the further objection that but a small amount of indexing is practicable, and that of a very general character. To illustrate this take the following example from this publication. In the notice of the Monograph on the Denver Basin of Colorado, by Emmons, Cross and Eldridge, the index number given is 551.7. 55 refers to geology, 551 to the physical structure of the globe, and 551.7 to stratigraphy. Indexing under such general headings conveys a very inadequate conception of the extent and character of this publication. To index it with some degree

of detail would require something like this: 549.8, 551.35, .4, .49, .71, .751, .762, .763, .78, .79, 552.11, .13, leaving out entirely the part relating to paleontology. Translating these numbers we have: 549, mineralogy; 549.8, combustible materials, coal; 55, geology; 551, physical structure of the globe; 551.35, erosion; 551.4, physiography; 551.49, hydrography; 551.71, pre-Cambrian; 551.751, Carboniferous; 551.762, Jurassic; 551.763, Cretaceous; 551.73, Tertiary; 551.79, Pleistocene; 552, lithology; 552.11, acid rocks; 552.13, basic rocks.

This is by no means an exceptional case, and there are many papers in this bibliography which require just such an analysis to give any one a satisfactory idea of their scope and character.

The attempt to classify our scientific knowledge by rows of figures will fail to meet the requirements of the average student. Any system, whatsoever, based on such a principle will require considerable effort to become sufficiently familiar with it to be readily employed, and it will be necessary to use it frequently in order to retain it in the memory. The average geologist will find it extremely inconvenient to fulfill either or both of these requisites.

F. B. WEEKS.

U. S. GEOLOGICAL SURVEY.

SCIENTIFIC JOURNALS.

American Chemical Journal, June: 'The Action of Zinc on Copper Silicide:' By G. DE CHALMOT. When molten zinc is added to melted copper silicide the two metals combine and the silicon separates in a crystalline condition. 'On the Colored Compounds obtained from Sodic Alcoholates and Picryl Chloride:' By C. L. JACKSON and W. F. BOOS. A number of complicated compounds have been isolated and studied. On the 'Action of Orthodiazobenzenesulphonic Acid on Methyl and Ethyl Alcohol:' By E. C. FRANKLIN. In these experiments the alkoxy reaction alone took place. The only effect due to increase in pressure was an increase in the yield of the alkoxy product. The action of nitric acid on the amides was also studied. 'On the Taste and Affinity of Acids:' By J. H. KASTLE. In a series of experiments the author found that those acids which were stronger had the sourer taste. 'The Action of Nitric Acid on Tribromacetanilide:' By W. B. BENTLEY. The author was unable to obtain the nitric product described by Remmers. 'Researches on the Cycloamidines, Pyrimidine Derivatives:' By H. L. WHEELER. 'Some Double Salts Containing Selenium:' By J. F. NORRIS. 'On Phenylglutaric Acid and its Derivatives:' By S. AVERY and ROSA BOUTON. 'On α-Methyl-β-Phenyglutaric Acid:' By S. AVERY and M. L. FOSSLER.

J. ELLIOTT GILPIN.

THE *American Journal of Science* for June, which completes Volume V. of the 4th series, contains as its first and longest article an account of the stratification of the electric discharge in Geissler tubes, with a theory of their cause and an account of some experiments made to test it. There are short articles on geological and mineralogical subjects by Messrs. W. Lindgren, H. W. Turner, J. H. Pratt, H. F. Bain and H. S. Washington. Mr. R. G. Leavitt describes a psycrometer, and Mr. L. C. Jones the action of carbondioxide on soluble borates. The number concludes with an article by Dr. F. H. Bigelow, reviewing his recently published bulletin of the Weather Bureau on solar and terrestrial magnetism in their relations to meteorology.

Appleton's Popular Science Monthly for June contains a portrait and sketch of Andrew Crombie Ramsay. Professor Heilprin continues his account of aspects of nature in the Sahara, and Dr. G. A. Dorsey describes a cruise among Haida and Tlingit villages of the Northwest coast. Professor D. R. McAnally writes on the Roman highways, and Dr. W. L. Howard on the physiology of strength and endurance. There are two articles on scientific education and an article by Professor W. H. Hudson on veracity. In so far as the *Monthly* is 'timely' it has the courage of its convictions and publishes an article on 'Peace as a Factor in Social and Political Reform' and an editorial entitled 'A Victim of Militarism.'

THE publication of a monthly *Revista di scienza biologiche* under the editorship of Professor Enrico Morselli is announced. It proposes to cover somewhat the same field as the

American Naturalist and *Natural Science* and has the coöperation in England of Sir John Lubbock and in America of Professor J. Mark Baldwin. Subscriptions may be addressed to Dr. Paulo Celesia via Assarotte 46. Genoa.

MESSRS. JOHN BALE, Sons and Danielsson, London, announce the publication of a *Journal of Tropical Medicine* to be edited by Mr. James Cantlie, who for some years practiced in Hong Kong, and by Dr. W. J. Simpson, who was until recently medical officer of health for Calcutta.

THE State Board of Health of Michigan has established a Teachers' Sanitary Bulletin to be issued monthly. It promises to contain information of great value to the teacher, and sets an example that could be followed to advantage in other States. The first numbers contains an address by Dr. F. G. Novy on 'germs, what they are, and how they produce diseases,' and an article by Dr. H. B. Baker on 'isolation and disinfection of persons and things.' The number also contains several statistical charts.

MR. JAMES G. BIDDLE, of Philadelphia, has begun the publication of a monthly Bulletin intended to be of interest to those who use scientific instruments. The subscription price is 50 cents per annum.

SOCIETIES AND ACADEMIES.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 80th meeting, held in Washington on May 25, 1898, Dr. A. C. Spencer and Dr. Geo. H. Girty read a joint paper on the Devonian in Southwestern Colorado.

In one of the early bulletins of the Hayden Survey, F. B. Meek described a small collection of fossils which had been brought in from the southwesterm part of Colorado by F. M. Endlich. The specific characters of a *Rhynconella*, which was very abundant, led him to designate the age of the limestone in which they occurred as Devonian. Some weight was added to this opinion by associated forms which were only generically recognizable. During the field season of 1897 *Rhynconella endlichi*, which has since been assigned to Camarotœchia (Plethorhyncha), was found associated with a number of forms which corroborate Meek's determination as against those who have supposed a probable Carboniferous age. The Devonian strata lie in apparent conformity with a supposed Carboniferous section.

The stratum from which the fossils were obtained is a heavy limestone about 100 feet thick. Below it there are about 50 feet of shales not well exposed and a heavy quartzite 50 feet in thickness which rests upon an eroded surface of crystalline rocks. A basal conglomerate is locally present. The following forms have been identified by Dr. Girty: *Fenestella* sp.; *Orthothetes Chemungensis?* *Productella* cf. *spinulicosta;* *Rhynchonella* sp.; *Camarotœchia* (*Plethorhyncha*) *Endlichi*; *Cyrtia* n. sp. *a*; *Cyrtia* n. sp. *b*; *Athyris* sp.; *Naticopsis gigantia?* *Euomphalus* sp.

The last paper of the evening was one by Mr. S. F. Emmons, on the 'Geology of Southern Russia,' illustrated by lantern slides. This included some account of Donetz Basin, which has been developed within the last ten or fifteen years, and promises to become one of the most important industrial centers of the Empire, containing large areas of coal of various kinds as well as important deposits of mercury and rock salt, together with ores of gold, silver, lead, zinc and iron as yet imperfectly developed. Some account was given of the Caucasus mountains, their geological structure and the varied races that dwell within their valleys; also of the important deposits of petroleum in the Tertiary beds along their flanks, especially of those at Bakou, on the Caspian Sea, which already rival in the amount of their production those of the United States. The enormous deposits of glauber salts in the Karabugas gulf, on the eastern side of the Caspian, their origin and their bearing upon the origin of petroleum, were also described. Likewise the peculiar conditions of the waters of the Black Sea, their greater salinity, higher temperature, contents of H_2S and entire absence of organic life below the 100-fathom level, and the points of resemblance between their condition and those that prevail in the Arctic Ocean, as found by Nansen. Finally, the interesting geological features of the Crimean peninsula, which appears to be a segment of the northern flanks of the Caucasus, left upon engulfment of the rest of this portion of the range beneath the waters of the Black Sea.

In addition to the above, Dr. W. F. Hillebrand read an important paper on the 'Distribution and Quantitative Occurrence of Vanadium in the Rocks of the United States,' but to attempt to abstract it here would not give satisfactory results.

WM. F. MORSELL.

TORREY BOTANICAL CLUB.

THE scientific program on March 30th included three papers, of which the first, by Dr. V. Havard, Surgeon U. S. A., was upon 'The English Names of Plants.' He said that, the necessity for English names being recognized, botanists should decide on the principles which are to determine their selection and formation, so as to secure greater uniformity, simplicity and usefulness. To each plant an authorized vernacular binomial should be assigned, so that ambiguity and confusion may be avoided. In the absence of suitable English names, already recognized, it seems best to adopt the Latin genus name, if short and easy, like *Cicuta*, *Parnassia*, *Kalmia*, *Hibiscus*, or a close translation thereof, when possible, like *Astragal*, *Chenopody*, *Cardamin*, while the specific English name should be an equivalent of the Latin one or a descriptive adjective.

As to construction, the rules recommended are as follows: In case of all English binomials clearly applying to well-known individual species and no others, all substantives are capitalized without hyphen, as in Witch Hazel, May Apple, Dutchman's Pipe. In all genera in which two or more species must be designated, the genus name is compounded into one word without hyphen, as Peppergrass, Sweetbrier, Goldenrod, Hedgenettle, etc., except in long names, where the eye requires the hyphen, as Prairie-clover, Forget-me-not. Genus names in the possessive case (St. John's-wort) are written with the hyphen followed by a lower-case initial. Plants commemorating individual men (Douglas Spruce, Coulter Pine) are written without the marks of the possessive. In specific names participial endings are suppressed, the participle becoming a substantive which is added as a suffix, without hyphen, thus Heart-leaved Willow is changed to Heartleaf Willow.

Discussion followed, Dr. Britton, Mr. Clute, Mr. Rydberg, the Secretary and others participating. Commendation was given to the attempt to simplify, to make use of the vernacular, and to secure greater euphony. President Brown and Dr. T. F. Allen deprecated the manufacture of book-names. Dr. Allen also pointed out the confusion which has resulted from the improper transfer of English and German names to plants which are kindred but not identical. Professor Burgess defended the use of vernacular names, saying that they deserve more attention, and that in their absence the generic name should be used unchanged. "Many Latin names, as *Portulaca*, win their way without change as soon as once fairly made familiar. Coined names seldom live; a name to be successful must be a growth, as language is. Allowance must be made for new discoveries, even in supposed monotypic genera. Names like Witch-hazel are fitly treated as themselves generic, not binomial. To drop the possessive often loses from our thought an association with the discoverer which is worth preserving. To drop the participle ending -ed is often, however, a distinct gain, both in securing compactness and expressiveness."

The second paper, by Dr. N. L. Britton, 'The Genus *Parthenium* in Eastern North America,' was a description of a new species of Parthenium, from near Charlotte, Va., intermediate in leaf-margin between the pinnatifid leaves of tropical species and the subentire leaves of the type *P. integrifolium*. Plants of the latter from White Sulphur Springs, Va., are now cultivated at the New York Botanic Garden.

The third paper, 'The Influence of the Nucleus upon the Formation of Cell Walls,' was by Professor C. O. Townsend. "It was observed by Klebs (Pfeffer, Untersuch. a. d. Botan Institute z. Tübingen, Bd. II., p. 500) in 1888 that when cell contents are separated into two or more parts by plasmolysis, only the part containing the nucleus is capable of forming a new cell wall. In the following year Palla (Flora, p. 314) performed a series of experiments in which cell walls seemed to be formed around the nucleus-free protoplasmic masses. The experiments undertaken in 1895 by the writer (Pringsheim's Jahrbücher, 1897) were solely to determine whether or not the nucleus is neces-

sary for the formation of cellulose. It was found that when the cell contents were plasmolysed, the protoplasmic masses usually remained connected by protoplasmic threads. When these threads were broken, so that there was no possible connection with a mass of protoplasm containing a nucleus, no new cell walls were formed. If a protoplasmic mass was completely separated from the nucleus in its own cell it was found that the influence necessary for the formation of cell walls could travel from the adjacent cells by means of the protoplasmic connections. Simple contact without living protoplasmic connections was not sufficient to induce the formation of cell walls. If, however, the protoplasmic connections were not broken the influence of the nucleus was capable of traveling over a distance of several millimeters."

EDWARD S. BURGESS,
Secretary.

NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY AND MINERALOGY, MAY 16, 1898.

MR. GEO. F. KUNZ exhibited specimens of quartz crystals found in massive gypsum from Gallineo Springs, New Mexico, and announced the discovery of a new meteorite from Ottawa, Kansas.

The first paper on the program was by Professor D. S. Martin on 'The Geology of Columbia, South Carolina, and its Vicinity.' Professor Martin described the granitic and gneissic rocks of that region and their residual products. He also commented on the character of the Potomac, Lafayette and Columbia formations, which are well exposed in the railroad cuts to the south of the city.

The paper was discussed by Professor Dodge and Dr. Ries.

The next paper of the evening was by Professor Kemp, entitled 'Some Remarks on Titaniferous Magnetites.' The speaker discussed the formula of ilmenite, and stated that it was probably a mixtnre of $FeOTiO_2$ and nFe_2O_3. The amount of titanium present in the titaniferous magnetites is very variable, running sometimes as high as 40%; in the Adirondack areas it is 10–20%.

Magnetic separation has not yet proved successful for the elimination of titanium from these ores. Nearly all of the titaniferous magnetites show small amounts of MnO, Cr_2O_3, CoO, NiO and MgO. The latter suggests the presence of spinel. SiO_2 and Al_2O_3 have also been found, and V_2O_3 has been recorded in a few instances. Professor Kemp suggested that these minor constituents might have some influence on the metallurgical behavior of the ore. Phosphorus and sulphur are very rare. The native and foreign occurrences of the titaniferous magnetites were also alluded to.

The paper was discussed by Professor Martin, Dr. Ries and Mr. Kunz.

HEINRICH RIES,
Secretary of Section.

BOTANICAL SEMINAR OF THE UNIVERSITY OF NEBRASKA.

AT the meeting of the Botanical Seminar of the University of Nebraska on April 23d papers were read as follows: 'Recent Investigation of the Cyanophyceæ,' by F. E. Clements; 'The Morphology of Ginkgo,' by C. E. Bessey; 'Hitchcock's Ecological Plant Geography of Kansas,' by Roscoe Pound; 'Cell Division in Ascomyceteæ,' by A. T. Bell.

At the meeting on May 21st the following papers were read: 'The Proper Conception of Plant Ecology and Plant Geography,' by Roscoe Pound; 'Vegetation Pressure,' by F. E. Clements; 'The Development of the Pistils of Alismaceæ, Ranunculaceæ and Rosaceæ,' by Ernest A. Bessey.

NEW BOOKS.

Revised Text-book of Geology. JAMES D. DANA. Edited by WM. NORTH RICE. New York, American Book Co. 1898. Pp. ix+482.

La famille Néuropathique. CH. FÉRÉ. Paris, Alcan. 1890. Pp. 352.

A Manual of Quantitative Chemical Analysis. E. F. LADD. New York, John Wiley & Sons. 1898. Pp. vi+82.

Political Crime. LOUIS PROAL. New York, D. Appleton & Co. 1898. Pp. xxii+355.

Die Zelle und die Gewebe. OSCAR HERTWIG. Jena, Gustav Fischer. 1898. Pp. viii+314. 7 Marks.

SCIENCE

FRIDAY, JUNE 17, 1898.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE VITAL EQUILIBRIUM AND THE NERVOUS SYSTEM.

IT is noticeable that there has been a tendency on the part of our most thoughtful working biologists, especially such as are equally equipped for the philosophical and biological aspects of cellular biology, to seek some avenue of return to the vitalistic point of view. It has become sufficiently plain that the most conspicuous triumphs of histology, even in the domain of cytology, have rather reduced than increased the probability of securing an explanation of vital phenomena and specific heredity and integrity from the study of structure alone. A strong tendency is visible toward a dynamic point of view. We believe that a consistant application of a dynamic hypothesis is destined to prepare the way for greater advances, not only in interpretation, but also in practical applications of biological principles. When we come to regard the visible structural data of histology as expressions of dynamic processes rather than the causes of these processes, and when we have agreed to apply other criteria than that offered by materialism to the phenomena of heredity, we may be able to shake ourselves free of preconceptions that have done much to retard the normal development of both biology and psychology. It is true that a strong prejudice exists against the dynamic method because of the belief that it tends to limit research and

thus deprives science of its necessary footing upon observation. If the criticism be just as applied to those who have sought to escape from the crudities and limitations of materialistic theories, it certainly should be recognized that there is no reason why the believer in dynamism should not scrutinize the pictures presented by histology as carefully as his colleague who ascribes to matter all the phenomena that science recognizes in cellular biology. In fact, the dynamist should have greater interest in the details of such appearances, for he may believe that every curve must be the function of a dynamic problem and that every change is the resultant of the composition of forces which are the very realities with which he has to do.

In no field have the results of too implicit reliance on the structural categories worked more plainly to retard progress than in neurology. It seems to be assumed that after nervous mechanisms were differentiated in the animal kingdom all other parts of the body at once and forever lost their original quota of what may be termed the power of vital equilibrium. When the preeminent adaptation of the nervous system to the function of correlation was recognized it was not unnatural that the inherent tendency to vital coordination on which the coherence of the body depends during its entire life should be minimized or ignored. Especially when the application of the methylen blue and silver impregnation revealed a hitherto unexpected wealth of nervous connections, it was natural to think of the body as linked together by a complete nervous mechanism to such an extent that all coordinations are dependent on the persistence of the nervous continuum. Even admitting the practical ubiquity of nervous elements within the body, sundry curious coordinations remain to be explained apart from any known basis of nervous control. It may suffice to mention the following: It is evident that during the embryonic stages of higher animals, as well as throughout the life of many lower forms, a very complete and active coordination and trophic equilibrium exists, which suffices to superintend the structural differentiation and for the maintenance of the body under circumstances where nervous influence as such is excluded. Again, the wandering cells and blood corpuscles, and probably part at least of the chromatophores, are certainly coordinated under vital control, though not under direct or permanent nervous influence. Lastly, the vegetable kingdom furnishes us with structures scarcely less complicated than those of higher animals, but, in spite of the high degree of specialization and individuality and the perfection of the correlation of part with part, nothing analogous to a nervous system has been discovered. Yet in plants there is a remarkable condensation of the characters of the individual in every individual part, in so much that the smallest fragment of one of the Bryophyta may reproduce a new individual. These commonplaces of biology are cited to illustrate the fact that the body of a plant or animal may be very completely coordinated, and each part may be stamped in some way with the influence of the whole body without the necessary participation of the nervous mechanism.

On the other hand, we have the best of evidence that all nervous action is trophic, and that processes going on in extra-neural tissues are influenced by nerve currents, and that neural equilibrium is also influenced by the somatic-vital processes of cells among which the termini of nervous arborizations ramify. The conclusion is apparently warranted that while the nervous system is, in a sense, super-added upon a self-sufficient somatic equilibrium-system, and, accordingly, the higher nervous processes are, from the stand-point of the body, epiphenomena, yet there is no sharp line of demarkation between them and the somatic forces.

The search for the structural evidence for such coordination cannot be said to have been very successful, though the statements of numerous observers respecting 'intercellular bridges' and other means of communication have served to keep alive a spirit of expectancy. It is the purpose of this paper to offer an illustration of a structural basis for vital or somatic coordination which seems, so far as a cursory glance at the literature enables me to judge, not to have received any adequate interpretation. It may be said in advance that the prevailing idea that the body is made up of close ranks of cells set immovably in tissue as stones are cemented in a wall is applicable to comparatively few parts of the body. Any one who has observed the structure of the embryonic body, say of a vertebrate, must have been struck with the fact that the interspaces between the embryonic tissue are wonderfully permeable to the invasion of proliferating and migrating cells of all kinds, so that the developing nerve, for example, has no difficulty in reaching its destination as it grows by progressive proliferations at its tip. In the adult the brain offers an illustration of a similar permeability, and the effectiveness of the organ depends, in no small degree, upon the fact that nutriment-bearing cells make their way with great freedom among the neural elements. There can be no doubt that the brain cells are undergoing constant renewal, and it is now admitted that the degenerations observed in the cortex of paralytics can be duplicated in kind in the relatively normal brain.

Our own present illustrations are derived from the preparations of the skin of the axolotl and the horned toad, two subjects sufficiently different from each other to warrant us in believing that structures found in both are present quite generally, a least within the two classes they represent. The skin of the Amphibia has been so extensively studied that it may appear incredible that conspicuous structures should have escaped notice, but even should the details not prove entirely new the illustration is an apt one for my present purpose.*

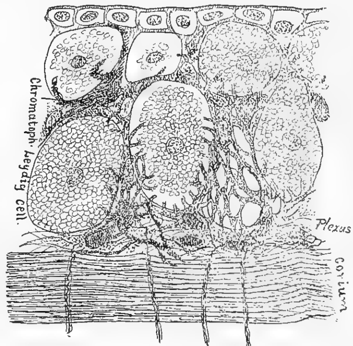

FIG. 1. Section through skin of axolotl hardened in Merkel solution ½, stained with picrocarmine and hæmatoxylin. Nerve fibres, passing through the corium, enter a plexus demonstrable by methylen blue, and non-medullated fibres ascend to attach themselves to the naked intercellular protoblasts which support the coarse reticulum. One Leydig cell is not cut by the section and over its surface the meshes are entire; in other cases only the cut ends are shown by focusing at different depths.

It happened that in the search for a histological method for the study of the cytoplasm various modifications of the chromic and osmic acid fixers were employed, and it was noticed that certain combinations of chrom-acetic and platinic chloride, when diluted with alcohol, gave remarkably fine fixation of protoplasmic structures without impairing their susceptibility to stains to the extent that osmic acid preparation notoriously does. After-treatment with hæmatoxylin and either fuchsin, or, still better, picrocarmine gave exceedingly distinct contrast stains. The protoplasmic structures

*They have been seen, as indicated beyond, but wrongly interpreted.

take on a deep red color, as do the nerve fibres and connective elements, and this contrasts finely with the deep but transparent purple of the nucleary structures. In such specimens we were gratified to find that the two distinct elements in the skin are clearly differentiated. The large (Leydig) cells are perfectly fixed, the cytoplasm displaying a complete vesicular structure, such as an examination during life under favorable circumstances sometimes reveals. Nucleary figures are clearly marked and shrinkage seems almost absent. The antagonistic effect of chromic acid and alcohol in the presence of a rapid fixer like platinic chloride seems here to have proved of great advantage. Compared with the best preparations by Flemming's method the latter appears at a great disadvantage because of shrinkage phenomena. The later method, however, is a valuable check because by it the contents of the cytoplasmic vesicles are demonstrated as dark globules, giving rise to the familiar coarsely granular appearance and giving evidence of a chemical difference between the vesicles and their contents. But sufficiently good specimens by either method, but especially such as were prepared by the alcohol modification of Merkel's fluid, showed that every individual cell of the larger series is wrapped in a delicate protoplasmic network which can be resolved into processes from protoblasts occupying the interstices among the Leydig cells. Often the meshwork can be traced from one cell over its neighbor, and there can be no doubt that the processes from separate protoblasts unite to form the general reticulum. It is also true that the protoblasts lie in all parts of the epithelial layer, both ectad and entad of the Leydig cells.

As already mentioned, this reticulum has been noticed by Paulicki in the Archv. f. mikroscopische Anatomie, Vol. XXIV., 1884, but in the paper referred to the maial had evidently been greatly shrunken, and as the result it appeared as finer, shriveled network, and the absence of double staining may have failed to reveal its protoplasmic nature. The author, although his drawings show the fibres embracing the Leydig cells and passing from one to the other, describes them as varicosities on the wall! Such a view is quite impossible after an examination of the specimens. It might be suggested that the naked protoplasmic network is simply a part of a continuous film covering these cells, and this possibly may be the case during the life of the tissues, though we incline to the belief that the reticular structure is rather the expression of streaming notions.

The variability in the size of the meshes speaks for the latter view, as do the distortions in parts of the skin that were folded or stretched during hardening. The meshwork is most pronounced in thicker parts of the skin, especially along the sides and back. Whether it is the function of this reticulum to supply nourishment to the large extra-vascular (Leydig) cells, or to afford the basis for a more direct coordination than would otherwise be possible, it would, in either case, remain true that trophic influence over the less plastic cells would be an essential part of its function.*

* Both Fitzinger and Paulicki (Arch. f. mik. Anat. Band XXIV., 2.) describe these bands as thickened ridges or varicosities of the walls of Leydig's cells, and the former even goes so far as to suggest that these 'rib-like thickenings of the cell-membrane serve for attachment of the intercellular bridges.' Paulicki says 'it may be assured that this meshwork is occasioned by a rib-like partial thickening of the cell-membrane,' though he mentioned that the meshes stain like the protoplasm. It is not strange that the methods and optic aids then at disposal should permit an error of this kind, but it is peculiar that the same writer should go on to say that he 'observed that a continuous frame-work extended over numerous Leydig's cells' and that similar meshes continued to adjacent epithelial cells. He also noticed, without discovering its significance, the fact that the epithelium cells are without walls, that is, are 'protoblasts.' In our specimens it is possible to find appearances

It is, in any case, of the highest importance to determine the rôle played by the nerves in this connection. In sections stained with hæmatoxylin and picrocarmine there is no difficulty in tracing the nerve fibres through the corium, for these fibres are medullated and stain conspicuously, but in the layer of chromatophores below the epithelium the fibres lose their sheaths and seem to blend with the bases of the protoblasts, giving rise to the meshwork just described. The fibres can often be traced to the immediate vicinity of the nuclei of these cells, but because of the lack of contrast between the protoplasm of the cells and the nerve fibres it is difficult to determine their respective limits. Methylen blue preparation stained *intra vitam*, in which only the nerve fibres are selectively impregnated, enable one to trace the medulated nerve fibres through the corium and into a subepithelial network, or in some cases into cells resembling small non-pigmented chromatophores, but which may be ganglion cells of the plexus. From the plexus, non-medullated fibres rise into the vicinity of the nuclei of the protoblasts and appear to end in knobs as described by Bethe. The results of the methylen blue method are to be interpreted with caution, but there can be no doubt that the opportunity for nervous control over the reticulum or pericellular network is most complete and extensive. The nerve plexus entad of the corium is most distinctly stained in methylen blue preparations and is of exquisite delicacy and supplies the fibres to the blood vessels and chromatophores.

An entirely different type of nerve ending is found in the skin of the head. The sense buds give with methylen blue the usual appearance of a perigemmular set of fibres, but it seems to us that there is too great haste apparent on the part of those who have abandoned the classical results of strictly histological methods which have demonstrated an entirely different type of intragemmal endings. It is customary at present to deny the ending of peripheral nerves in cells on principle, except in the case of the olfactory nerves. To be consistent, the same objections would prevent us from recognizing the olfactory cells as true cellular endings for the theoretical considerations which have led authors to set apart the olfactory nerve as distinct and different from other sensory nerves are, it is believed, based on false premises. In fact, the olfactory nerve is simply a persistent embryonic nerve, and its fibres are, like the early stages of all nerves, moniliform series of cells which have proliferated from a common source. Each segment of an ordinary nerve fibre is shown by embryonic and pathological evidence to be derived from a neuroblast united to its neighbors at either extremity. The nuclei of the sheath of Schwann are morphologically the nuclei of the neuroblasts which are represented in the segments to which they belong. In the second type of nerve endings it is possible to take either one or two alternatives. Either the terminal cell is an independent neurocyte developed *in situ*, or it is a somewhat differentiated segment of the nerve itself. There are some reasons for accepting the latter alternative in the present case. Such endings are best seen in the skin of the head of the tree-frog. Here it is easy to trace the nerves through the corium in bundles of three or more, and the fibres pass without interruption through the chromatophore-layer and lie in a special cavity of the skin in such a way that their tips end free in a pore connecting with the exterior.

The terminal portion is continuous with

like those figured by Paulicki, but we also find instances where the meshes of the network are broad bands rather than rib-like bodies and their continuity with the epithelium cell-protoplasm is perfectly obvious.

the medulated fibre which preserves its sheath up to the point where its large nucleus appears. The latter occupies the lumen and is quite conspicuous, while ectad of it the fibre is reduced to a sensory rod with small rigid styles or cilia at the apex. Such termini are quite generally distributed over the skin of the head and take the place of the buds found in other types. The double staining is exceptionally good, and teased preparations produced by pressure on the cover glass permit the isolation of the termini and their study under immersion lenses. It seems probable that the differences of opinion which still prevail in this matter are the result of the partial results of the different methods, and that the truth will be reached by an intelligent employment of the data from them all. In conclusion the writer desires to acknowldgee the substantial assistance rendered, especially in the laboratory manipulation on which this paper is based, by his friend Mr. G. E. Coghill, in collaboration with whom a more detailed report of the histological processes and results may be expected in the *Journal of Comparative Neurology* at no distant date.

C. L. HERRICK.
UNIVERSITY OF NEW MEXICO.

SOME EXPERIMENTS ON ANIMAL INTELLIGENCE.

THE results of a recent investigation on animal intelligence, the details of which are about to be published,* seem to be of sufficient general interest to deserve an independent statement here. The experiments were upon the intelligent acts and habits of a considerable number of dogs, cats and chicks. The method was to put the animals when hungry in enclosures from which they could escape (and so obtain food) by operating some simple mechanism, *e. g.*, by turning a wooden button that held the door, pulling a loop attached to the bolt, or pressing down a lever. Thus one readily sees what sort of things the animals can learn to do and just how they learn to do them. Not only were the actions of the animals in effecting escape observed, but also in every case an accurate record was kept of the times taken to escape in the successive trials. The first time that a cat is put into such an enclosure, some minutes generally elapse before its instinctive struggles hit upon the proper movement, while after enough trials it will make the right movement immediately upon being put in the box. The time records show exactly the method and rate of progress from the former to the latter condition of affairs. A graphic representation of the history of six kittens that learned to get out of a box $20 \times 15 \times 12$ inches, the door of which opened when a wooden button $3\frac{1}{2}$ inches long, $\frac{7}{8}$ inch wide, was turned, is found in the curves in Figure 1. These curves are formed by joining the tops of perpendiculars erected along the abscissa at intervals of 1 mm. Each perpendicular represents one trial in the box; its height represents the time taken by the animal to escape, every 1 mm. equalling 10 seconds. A break in the curve means that in the trials it stands for, the animal failed in ten minutes to escape. Short perpendiculars below the abscissa mark intervals of twenty-four hours between trials. Longer intervals are designated by figures for the number of days or hours. The small curves at the right of the main ones are, as the figures beneath them show, records of the skill of the animal after a very long interval without practice. This process of associating a certain act with a certain situation is the type of all the intelligent performances of animals, and by thus recording the progress of a lot of animals, each in forming a lot of each kind of associa-

* Animal Intelligence; An Experimental Study of the Associative Processes in Animals; *Psychological Review*, Supplement No. 8.

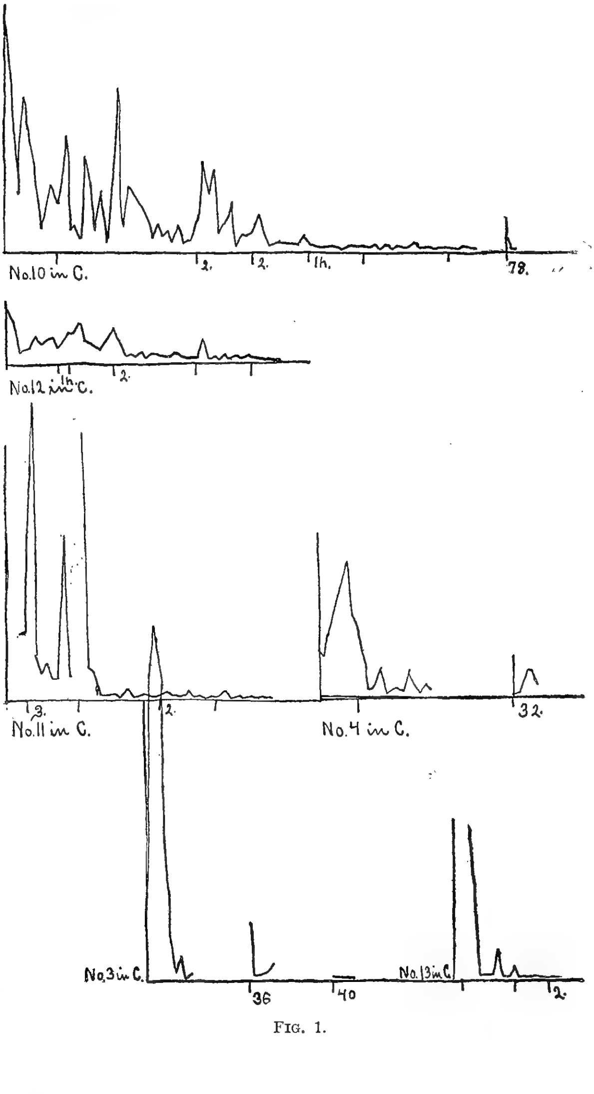
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FIG. 1.

tion, one gets a quantitative estimate of what animals can learn and how they learn it.

What happens in all these cases is this: The animal on being put into the box, and so confronted with the situation 'confinement with food outside,' bursts forth into the instinctive activities which have in the course of nature been connected with such a situation. It tries to squeeze through any openings, claws and bites at the walls confining it, puts its paws through and claws at things outside trying to pull itself out. It may rush around, doing all this with extraordinary vehemence and persistence. If these impulsive activities fail to include any movement which succeeds in opening the door, the animal finally stops them and remains quietly in the box. If in their course the animal does accidentally work the mechanism (claw the button round, for instance), and thus win freedom and food, the resulting pleasure will stamp in the act, and when again put in the box the animal will be likely to do it sooner. This continues; all the squeezings and bitings and clawings which do not hit the vital point of the mechanism, and so do not result in any pleasure, get stamped out, while the particular impulse, which made the successful clawing or biting, gets stamped in, until finally it alone is connected with the sense-impression of the box's interior, and it is done at once when the animal is shut in. The starting point for the formation of any association is the fund of instinctive reactions. Whether or not in any case the necessary act will be learned depends on the possibility that in the course of these reactions the animal will accidentally perform it. The progress from accidental performance to regular, immediate, habitual performance depends on the inhibiting power of effort without pleasure and the strengthening by pleasure of any impulse that leads to it.

Although it was of the utmost importance to them to get out of the various boxes and was, therefore, certain that they would use to the full all their mental powers, none of the animals gave any sign of the possession of powers of inference, comparison or generalization. Moreover, certain of the experiments seem to take the ground from beneath the feet of those who credit reason to animals. For it was found that acts (*e. g.*, opening doors by depressing thumb-latches and turning buttons) which these theorizers have declared incapable of performance by mere accident *certainly can be so done.* It is, therefore, unnecessary to invoke reasoning to account for these and similar successes with mechanical contrivances, and the argument based on them falls to the ground. Moreover, besides destroying the value of the evidence which has been offered for the presence of reason in animals, the time-records give us positive evidence that the subjects of these experiments could not reason. For the slopes of the curves are *gradual.* Surely if a cat made the movement from an inference that it would open the door, it ought, when again put in, to make the movement *immediately.* If its first success was due to an inference, all trials after the first should take a minimum time. And if there were any slightest rudiment of a reasoning faculty, even if no real power of inference, the cat ought at least sometime, in the course of ten or twenty successful trials, to realize that turning that button means getting out, and thenceforth make the movement from a decision, not a mere impulse. There ought, that is, to be a sudden change from the long, irregular times of impulsive activity to a regular minimum time. The change is as a fact very gradual.

Finally, experiments made in another connection show that these animals could not learn to perform even the simplest acts by seeing another do them or by being put

through them by the experimenter. They were thus unable to infer that since another by pulling a string obtained fish, they might, or that since fish were gained when I pushed round a bar with their paws it would be gained if they pushed it round themselves.

Experiments were made on imitation by giving the animals a chance to see one of their fellows escape by clawing down a string stretched across the box, and then putting them in the same box alone. It was found that, no matter how many times they saw the act done, they could not thereby learn anything which their own impulsive activity had failed to teach them, and did not learn any more quickly what they would have sooner or later learned by themselves. One important consequence of these results is the resulting differentiation of the Primates from the other orders of mammals. If the Primates do imitate and the rest do not, we have located a definite step in the evolution of mind and given a new meaning to the line of human ancestry. I do not, however, hold that these results eliminate the possibility of an incipient faculty of imitation among mammals in general. They do deny the advisability of presupposing it without proof, and emphatically deny its presence in anything equivalent to the human form. Finally many actions which seem due to imitation may be modifications of some single instinct, such as that of following.

Perhaps the most valuable of the experiments were those which differentiate the process of association in animals from the ordinary 'association by contiguity' of human psychology. A man, if in a room from which he wishes to get out, may think of being outside, think of how he once opened the door, and accordingly go turn the knob and pull the door open. The *thought* of opening the door is sufficient to arouse the act of opening the door, and in most human association-series the *thoughts* are the essential and sufficient factors. It has been supposed that the same held true of animals, that if the thought *of doing* a thing were present an impulse *to do* it would be readily supplied from a general stock. Such is not the case. *None of these animals could form an association leading to an act unless there was included in the association an impulse of its own which led to the act.* Thus cats who had been induced to crawl into a box as the first element in a pleasurable association-series soon acquired the habit of crawling in of their own accord, while cats who had been *dropped in* did not. In the second case the *idea of being in* would be present as strongly as in the first, but the particular *impulse to go in* was not. So also cats who failed of themselves to learn certain acts could not be taught to do them by being put through them, while cats who were thus put through acts which accident would of itself alone have taught them, learned them no more quickly and often made the movement in a way quite different from that which they were shown. Their associations are not primarily associations of ideas with ideas, but associations of sense-impressions and ideas *with impulses to acts, muscular innervations.* The impulse, the innervation, is the essential.

This does not mean that the animals can have no representations or images at all. Another set of experiments show that they probably can. It means that they have no stock of free-floating impulses which can be called on at will; that the elements of their associations occur chiefly just in their particular connections; that their ideational life consists not of a multitude of separate ideas, but of a number of specific connections between ideas and impulses.

Having thus denied that animal association is homologous with human association, as the latter is ordinarily conceived, we find the true homologue of animal associa-

tion in the mental process involved when a man learns to play tennis or billiards or to swim. Both contain sense-impressions, impulses, acts, and possibly representations. Both are learned gradually. Such human associations cannot be formed by imitation or by being put through the movement. Nor do its elements have any independent existence in a life of free ideas apart from their place in the associations. No tennis player's stream of thought is filled with representations of the tens of thousands of sights he has seen or movements he has made on the tennis-court, though his whole attention was on them at the time.

The great step in the evolution of human intellection is then not a jump to reason through language, but a change from a consciousness which equals a lot of specific connections to a consciousness which includes a multitude of free ideas. This is the prerequisite of all the human advance. Once get free ideas in abundance, and comparison, feelings of transition or relation, abstractions and 'meanings' of all sorts may emerge. In this respect, as in imitation, the monkeys bear the marks of their relationship.

Besides the experiments resulting in this new analysis of the mental processes of animals, others were made to discover the delicacy, complexity, number and permanence of their associations. It was found that naturally they discriminate very little, that what they react to is a vague, unanalyzed total situation. Thus, cats that had learned to climb up the front of a cage on hearing the words, 'I must feed those cats,' would climb up just as readily if you said, 'What time is it?' or any short sentence. By associating only the right reaction with pleasure, however, you can render the association delicate to any degree consistent with their sense powers. For instance, a cat was taken that was just beginning to form the association between the words, 'I must feed those cats,' and the act of climbing up the front of the cage (after she climbed up she was given a bit of fish). She was now given a lot of trials, some as just described, some with the signal changed to, 'I will not feed them.' At these trials she got no fish. The purpose was to see how many trials would be required before she would learn always to climb up at the "I must feed" and always stay down at the "I will not." The two sorts of trials were mixed indiscriminately. 60 of the "I must feed"'s were, in addition to its previous training, enough to make the proper reaction to it inevitable. 380 of the 'I will not''s were required before perfect discrimination between it and the former signal was attained.

It was found that complex associations (such, *e.g.*, as the way to escape from a box where the door fell open only after a platform had been pushed down, a string clawed and a bar turned around) were very slowly formed and never really formed at all. That is, the animals did not get so that they went through the several acts in a regular order and without repeating uselessly one element. In respect to delicacy and complexity, then, we see a tremendous difference between association in animals and association in man.

Equally great is the difference in number. A practised billiard player has more associations due to just this one pastime than a dog has for his whole life's activity. The increase in the number of associations is a sign, and very likely a cause, of the advance to a life of free ideas. Yet, small as it is, in comparison with our own, the number of associations which an animal may acquire is probably much larger than previous writers have fancied.

A great many experiments were made on the permanence of associations after from 10 to 70 days. Samples of the results will

be found in the figure given. What an animal once acquires is long in being lost, and this power of retention thus renders the power of acquisition a big factor in the struggle for existence. But these experiments give better information than this quantitative estimate of the value of past experience, for they demonstrate conclusively that the animals have no real memory. The cat or dog that is put into a box from which he has escaped thirty or forty times, after an interval of fifty days without any experience with it, will escape quicker than he did in his first experience and will reach a perfect mastery of the association in much fewer trials than he did before, but he will reach it *gradually*. If he had true memory he would, when put in the box after the interval, after a while think, "Oh, yes! pulling this string let me out," and thenceforth would pull the string *as soon as dropped in the box*. In the case of genuine memory you either know a thing and do it or forget it utterly and fail to do it at all. So with a man recalling the combination to a safe, for instance. But the memory of the animal is only that of a billiard player who hasn't played for a long interval and who gradually recovers his skill. No billiard player keeps thinking, "Two years ago I hit a ball placed like this in such and such a way." And the cat or dog does not think, "When I was in this box before, I got out by pulling that string." Not only the gradual recovery of skill, but also the actions of the animal show this. In case of an association only partially permanent the animal claws around the vital spot, or claws feebly and intermittently, or varies its attacks on the loop or what not, by instinctive bitings and squeezings. Memory in animals is permanence of associations, not conscious realization that a certain event or sequence occurred in the past.

So much for some of the experiments and what theoretical consequences they seem directly to involve. The general view which the entire investigation has forced upon me is that animals do not think *about* things at all, that consciousness is for them always consciousness in its first intention, 'pure experience,' as Lloyd Morgan says. They feel all their sense-impressions as we feel the sky and water and movements of our body when swimming. They see the thumb-latch as the ball-player sees the ball speeding toward him. They depress the thumb-piece, not because they think about the act, but just because they feel like doing so. And so their mental life never gets beyond the limits of the least noticeable sort of human intellection. Conception, inference, judgment, memory, self-consciousness, social consciousness, imagination, association and perception, in the common acceptation of the terms, are all absent from the animal mind. Animal intellection is made up of a lot of specific connections, whose elements are restricted to them, and which subserve practical ends *directly*, and is homologous with the intellection involved in such human associations as regulate the conduct of a man playing tennis. The fundamental phenomenon which I find presented in animal consciousness is one which can harden into inherited connections and reflexes, on the one hand, and thus connect naturally with a host of the phenomena of natural life; on the other hand, it emphasizes the fact that our mental life has grown up as a mediation between stimulus and reaction. The old view of human consciousness is that it is built up out of elementary sensations, that very minute bits of consciousness come first and gradually get built up into the complex web. It looks for the beginnings of consciousness to *little* feelings. This our view abolishes, and declares that the progress is not from little and simple to big and complicated, but from direct connections to indirect connections in

which a stock of isolated elements plays a part; is from 'pure experience' or undifferentiated feelings to discrimination, on the one hand, to generalizations, abstractions, on the other. If, as seems probable, the Primates display a vast increase of associations, and a stock of free-swimming ideas, our view gives to the line of descent a meaning which it never could have so long as the question was the vague one of more or less 'intelligence.' It will, I hope, when supported by an investigation of the mental life of the Primates and of the period in child life when these directly practical associations become overgrown by a rapid luxuriance of free ideas, show us the real history of the origin of human faculty.

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

THE American Society of Mechanical Engineers held their spring meeting at Niagara Falls, May 31st to June 3d, inclusive. The reception was initiated by Mayor Hastings in an interesting and cordial address, and by Mr. Coleman Sellers, and Mr. W. A. Brackenridge, who described with lantern-illustrations the work of the Cataract Construction Company. In addition to Society business, the time was given to visits to points of professional interest, at Niagara and at Buffalo and adjacent towns, and, later, at Dunkirk and at Toronto.

Some very important papers were read, Mr. Barrus made a 'Plea for a Standard Method of Conducting Engine Tests'; intending particularly tests of mill-engines; the Society having already, through special committees, established precise methods of engine trial for steam pumping engines and locomotives, and of steam-boilers, which have been accepted as models, almost universally. A standard is now proposed that shall be general and cover the whole field. Mr. Bryan Donkin, an English member of the association, proposes an extension of these systems into other countries. The American Society having led the way in instituting such formal programs, steps should be now taken to secure general adoption throughout the world.

Mr. James See presented a very concise discussion of the principal points to be considered in patenting new devices. Mr. W. H. Bryan discussed 'Relations Between the Purchaser, the Engineer and the Manufacturer,' a phase of economics which is attracting much attention among members of the engineering profession. Mr. G. A. Lowry gave an interesting outline of the development of the industry of ginning and baling cotton, and of the inventions which have brought about its remarkable progress. Messrs. Woolson, Baker, Norton, Cole, Johnson and others discussed the construction, setting and details of steam-boiler practice. Mr. Benjamin detailed results of investigation of the strength of cast-iron cylinders, and Professor Carpenter reported the outcome of the extensive Sibley College researches on the properties of the aluminum alloys, with the various other useful metals and experiments upon the value of a remarkable new seamless tube. Dr. Thurston illustrated a variety of novel 'Graphic Diagrams and Glyptic Models,' employed for representation of the laws of variation of strength of materials of engineering and the economics of the steam engine, mainly of his own devising for use in his researches in these departments.

R. H. THURSTON.

BOTANICAL NOTES.

BOTANY AND AGRICULTURE.

IN the Proceedings of the Eighteenth Annual Meeting of the Society for the Pro-

motion of Agricultural Science, just received, several of the papers have considerable botanical interest. W. R. Lazenby, in a paper on the 'Annual Growth of Forest Trees,' makes the statement that "the greatest annual increase in diameter took place on the side most fully exposed to the light, but the greatest growth in length of branches was often on the side not fully exposed." R. C. Kedzie, in 'The Ash of Epiphytes,' answers the question of the supply of mineral matter to epiphytes by first calling attention to the economical use of the supply on hand. In speaking of the orchids he says: "Note the thin and papery remains of their leaves, and see how carefully mineral matter has been removed from these cast-off clothes of the plant, and how they differ from the leaves of terrestrial plants." He then enumerates the following sources of mineral plant food: (1) soil water with which the plants are often watered; (2) winds which carry considerable amounts of mineral matter; (3) the bark of trees which supports the epiphytes and also the pottery, etc., used for supports in conservatories; (4) very often in nature the roots of orchids grow in a mass of decaying leaves which have fallen from the trees and lodged about the plants. B. D. Halsted contributes some 'Notes upon Bean and Pea Tubercles,' which are due to the presence of a parasite, *Rhizobium leguminosarum*. It was found that larger crops resulted from plantings upon ground known to be infested with these parasites.

PAPERS ON THE DISEASES OF PLANTS.

FROM Erwin F. Smith we have a paper on Wakker's Hyacinth Bacterium (Abstract in Proc. A. A. A. S. 46: 274) confirming fully the conclusions reached by Wakker in 1882–5, and extending quite materially our knowledge of the organism which is the cause of the disease. The same author's lecture on 'The Spread of Plant Diseases,' before the Mass. Hort. Society and published in its Transactions, is an excellent popular statement of our knowledge of the means by which certain parasites succeed in getting from one plant to another. He groups them under the following heads: (a) spread by insects; (b) spread by slugs and snails; (c) spread through the manure pile; (d) spread by way of the soil; (e) spread by way of seeds, seedlings, buds, tubers, cuttings and nursery stock. In a third paper the same author discusses (Trans. Peninsular Hort. Soc. 1898: 142) 'Some Bacterial Diseases of Truck Crops,' noticing the 'wilt' of the cucumber, 'Brown Rot' of the potato, and 'Black Rot' of the cabbage.

W. T. Swingle discusses 'The Grain Smuts' in Bull. 75, U. S. Dept. Agriculture, describing the stinking smuts of wheat (*Tilletia foetens* and *T. tritici*), loose smut of wheat (*Ustilago tritici*), loose smut of oats (*Ustilago avenae*), barley smuts (*Ustilago hordei*, *U. nuda*), rye smut (*Urocystis occulta*) and maize smut (*Ustilago maydis*). Directions for treating the seed and grain, including corrosive-sublimate, copper sulphate, formalin, potassium sulphide, and 'sar' solution, all of which are intended to kill the spores by poisoning are given. Jensen's hot-water treatment, also, is described and recommended for certain species.

F. C. Stewart in Bull. 138 of the Geneva (N. Y.) Experiment Station records his results, which show that the popular opinion that the plowing under of green rye will prevent potato scab (*Oospora scabies*) is erroneous. He concludes, also, that the potato-stem blight is not due to the presence of fungi or bacteria, but that, on the contrary, it is a pathological condition, not communicable. The practice of some florists of spraying carnations to prevent carnation-rust (*Uromyces caryophyllinus*) is shown to be useless; the salt application neither prevents the rust nor gives the

plants a more vigorous growth. The efficacy of spraying cucumbers with Bordeaux mixture to prevent attacks of Downy Mildew (*Plasmopara cubensis*) was demonstrated by an extensive experiment. Incidently Mr. Stewart records a new host, *Cucumis moschata* (winter crook-neck squash) for this mildew.

C. S. Crandall in Bull. 41 of the Colorado Expt. Station discusses 'Blight and other Plant Diseases,' bringing together in compact form the history of the investigation of blight, culminating with the discovery of the bacterium, *Micrococcus amylovorus* (*Bacillus amylovorus*), by Burrill in 1878–80, and the demonstration that this organism is the active cause, by Arthur in 1884–5.

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CURRENT NOTES ON ANTHROPOLOGY.

THE ARYAN QUESTION.

In the *Revue Mensuelle* for February, Dr. Zaborowski, a high authority, sums up the result of his long researches into the origin of the Aryans. At the beginning of the neolithic period, he tells us, the blond, long-skulled energetic Aryans of primitive stock occupied the plains of the center and north of Europe. They extended gradually to the west and the British Isles (peoples of the 'long barrows'), and to the east into Asia (Ossetes of the Caucasus, ancient Persians, etc.). Their migratory movements were accelerated during the neolithic period by the constant pressure of short-skulled Turanian tribes from northern Asia, who by their settlements and intermixture of blood have left profound traces in the present European peoples. It was during the early neolithic period that the division of the primitive Aryan tongue into its numerous dialects and languages took place under complicated conditions of tribal minglings.

POLYANDRY AMONG THE SEMITES.

There is a frequently quoted passage in Strabo which attributes a condition of the polyandry to the Semitic tribes of southern Arabia. This assertion has remained open to doubt for lack of supporting evidence, although the Israelitic proper name Ahab, 'brother of his father,' and that of the daughter of Sargon, Achat-Abi-sha, 'wife of her father,' indicate such a custom. In the *Proceedings* of the Berlin Anthropological Society for January, Dr. Hugo Winkler gives the translation of a Minæean inscription (Halévy, 504) which leaves no doubt of the correctness of Strabo's statement. From these facts he concludes that polyandry in its most extended form, that in which the communal wife belonged at the same time to both fathers and sons, 'was generally prevalent.'

It is well known that an allied method of marriage still obtains in various parts of the world, and even among the comparatively civilized inhabitants of Tibet.

THE 'FOLK-MIND.'

In the *Beilage* to the *Münchener Allgemeine Zeitung* (No. 76, 1897) the writer, Max Buchner, undertakes a general onslaught upon the works and the teachings of the eminent anthropologist Adolf Bastian. It were scarcely worth while to take serious notice of this feuilletonist, who humorously quotes some of the brain-twisting paragraphs of the 'Altmeister' as specimens of his style; but the main aim of the article is to overthrow the notion of the 'Völkergedanke,' as so often and diffusely presented by Bastian. This is an integral and indispensable part of his anthropological edifice and must not be given up lightly. That each human group (nation, folk) has its own peculiar way of looking at things and taking in ideas cannot be disputed. Upon this way its fate in the world's history largely depends. Such a folk-mind

arises from well-recognized and inflexible causes (environment, heredity, etc.). It is, therefore, a reality, not a closet creation. Herr Buchner has by no means destroyed it in his amusing attack on the great Berlin professor and his many books.

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NOTES ON INORGANIC CHEMISTRY.

THE use of coke ovens which permit the recovery of by-products has become established on the continent of Europe, and several plants have been established in this country. In the *Proceedings* of the Alabama Industrial and Scientific Society, Wm. H. Blauvelt gives a description of the Semet-Solvay oven at Ensley, Ala. The coal is coked in retort ovens, the usual change being $4\frac{1}{2}$ tons. The time of coking is twenty-four hours. The amount of gas given off is eight to ten thousand cubic feet per ton, a part of which is used to heat the retort and for steam to operate the plant, leaving considerable gas available for heating and lighting purposes. The ammonia recovered is 16 to 22 pounds per ton, calculated as sulfate, and the yield of tar from 70 to 80 pounds. The yield of coke (75 per cent.) is ten per cent. higher than that obtained by the old beehive ovens. The cause of this is that the evolved gases, which are more or less completely burned in the beehive, are to some extent decomposed in the retort oven, graphitic carbon being deposited on the coke. In the beehive oven too some of the coke is consumed by the air present. The quality of the coke is pronounced equal to that produced in the old ovens, and some coals are available for coking which cannot be successfuly used with the beehive oven.

IN the *American Manufacturer*, W. B. Phillips gives the results of the Otto-Hoffman coke ovens at Jefferson Co., Ala. Here, using washed coal, the yield is: gas, 9,600 feet per ton, of which about 3,000 feet are available after all required on the plant; ammonium sulfate, 23.6 pounds; tar, 90 pounds; coke, 70 per cent. It is an encouraging sign to see the adoption in this country of industrial methods which have for their aim the saving of by-products.

IN an article on Aluminum as a reducing agent, in the *Chemiker Zeitung*, Léon Franck gives the following summary: Aluminum decomposes phosphates at high temperature, with evolution of phosphorus; in the presence of silica the liberation of phosphorus is almost quantitative. Aluminum forms several different compounds with phosphorus, Al_7P_3, Al_5P_3, Al_3P and AlP, all of which are decomposed by water with evolution of phosphin, PH_3. Carbon dioxid, carbon monoxid and carbonates are decomposed by aluminum with liberation of free carbon. Metallic oxids are decomposed giving the metal; sulfates, giving sulfur and sulfids; chlorids, giving the metal. A mixture of aluminum powder and sodium peroxid moistened with water burns spontaneously with a brilliant light. There are many possibilities of the development of the use of aluminum powder along technical lines.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

VASCO DA GAMA CELEBRATION.

THE festivities at Lisbon in commemoration of the discovery of India by Vasco da Gama began on May 15th. There were illuminations and fêtes both in the city and on the warships of various nations assembled in the harbor. The commemoration was also celebrated in Great Britain at a meeting of the Geographical Society on May 15th, at which addresses were made by the Prince of Wales, Lord George Hamilton, the Portuguese ambassador and by the President of the Society, Sir Clements Markham, who read a paper on 'Vasco da Gama,' in the course of which he said, according to the report in the London *Times*, that they were assembled to commemorate one of the

greatest events in the history of the world—the discovery of the ocean route to India by the Portuguese. Vasco da Gama completed the mighty enterprise on the day when the ghâts of India were sighted from the deck of his ship just 400 years ago. The credit of this discovery was due to the Portuguese people, to their constancy and heroic perseverance, even more than to the skill and ability of their leaders, and he thought that many of the illustrious navigators of Portugal were equal in merit and should be equal in renown. They contemplated the perseverance of this people and the continuity of their work during a century and a half of mighty effort rather than a single stroke of genius. Yet it was right that Vasco da Gama, who forged the last link, should have the first place which Camoens has assigned to him, *primus inter pares*. Prince Henry the Navigator gave the first impetus. At his death the work was continued, with almost equal zeal, by the Kings—his nephews—Alfonso the African, Joaö the Perfect Prince, Manoel the Fortunate. The Da Gamas came of an ancient, valiant and loyal house, their ancestors having fought by the side of Alfonso III. in the conquest of Algarve from the Moors and by the side of Alfonso V., 'the Brave,' at the battle of Salado. Estevan da Gama, their father, was chief magistrate of Sines, and here Vasco da Gama was selected by King Manoel to command his famous expedition when he was 28 years of age. His eldest brother, Paulo was equally fitted for the post, and he insisted upon accompanying and serving under Vasco, in command of the second ship. They both looked upon Nicholas Coelho, who was captain of a third ship, the Berrio, as their brother. The expedition sailed on Saturday, July 8, 1497; there were about 160 souls all told. The fleet was accompanied by the great navigator Bartholomew Diaz as far as the Cape Verde Islands. He was going out in a fast caraval to take up his command of the new Portuguese settlement of Lamina, on the coast of Guinea. In December the expedition reached Rio do Infante, the farthest point of Bartholomew Diaz, on the eastern side of Africa, and entered upon new ground. There was a mutiny at this critical time. The men feared to proceed farther, and wanted to return, according to Correa, who added that Vasco da Gama put the master and pilot in irons for giving the same advice and threw all their instruments overboard. His brother Paulo induced his crew to obey orders by argument and persuasions and interceded for Vasco's prisoners. The first experience of the explorers on entering the previously unknown ocean was the force of the current, so strong that they feared it might frustrate their plans, until a fresh stern wind sprang up, which enabled them to overcome it. This Agulhas current was first scientifically investigated by Major Rennell in 1777. Vasco da Gama passed the coast which was named by him 'Natal,' on Christmas Day, and was well received by the natives of Delagoa Bay. He was at Quilimane in January, 1498, at Mozambique in March, and he reached Melinde on April 15th. There was a terrible outbreak of scurvy off Mozambique and again on the way home, and then it was that Paulo da Gama proved the guardian spirit of the expedition, giving up all his own private stores for the use of the sick, ministering to them, and warding off despondency by his words of encouragement and by his example. The King of Melinde supplied the Portuguese with an Indian pilot, a native of Gujarat, and on April 24th the voyage was commenced across the Indian Ocean from the east coast of Africa to Malabar. A voyage of 23 days brought the adventurous discoverers in sight of the mountains above Malabar. And thus was the Portuguese empire in India founded by two of Portugal's noblest sons, Vasco and Paulo da Gama. On March 20, 1499, they cleared the Cape, and returned to Lisbon on September 18th. But Paulo da Gama had died at Terceira, in the Azores.

GENERAL.

SIR J. WOLFE BARRY and Professor Roberts-Austen, who are members of the committee appointed by the British government to report on the advisability of establishing a national physical laboratory in England have visited the Reichsanstalt and other technical institutions.

AT the anniversary meeting of the Linnæan Society, London, on May 24th, a special gold medal was presented to Sir Joseph Hooker on

the occasion of the completion of his monumental work, 'The Flora of British India.' The annual gold medal of the Society was, in accordance with the arrangements already announced, presented to Major G. C. Wollich.

THE University of California has conferred the degree of LL. D. on Professor J. M. Schaeberle in recognition of his services to the Lick Observatory.

THE Gilbert Medal of the Society of Arts for the present year has been awarded to Professor R. W. Bunsen, of Heidelberg, the eminent chemist.

SIR WILLIAM H. FLOWER, Director of the British Museum of Natural History, has received from the German Emperor the Royal Prussian Order *Pour le Mérite* in the Division of Science and Art.

DR. ANTON DOHRN, Director of the Zoological Station at Naples, has been elected an honorary member of the Stockholm Academy of Sciences.

DR. GUMLICH and Dr. Holborn have been appointed professors in the Reichsanstalt at Charlottenburg.

M. FALGUIÈRE has now completed the monument of Pasteur to be erected in Paris, opposite the Pantheon. The international subscription for the monument amounts to about $80,000.

A PORTRAIT of Dr. James W. McLane, Dean of the College of Physicians and Surgeons, Columbia University, has been presented to that University by the faculty of the College on the occasion of the retirement of Dr. McLane from the chair of obstetrics after a service of 25 years.

PROFESSOR FRIEDRICH MÜLLER, of the University of Vienna, the eminent ethnologist and philologist, died on May 25th. He was born at Jemnik, in Bohemia, in 1834.

THE death is also announced of Mr. W. M. Maskell, Register of the University of New Zealand, who had made valuable contributions to entomology.

THE trustees of the Fiske fund, Providence, R. I., have awarded the Fiske prize of $350 to Dr. D. I. Wolfstein, of the Ohio Medical College, for an essay on 'The Neuron Theory; its Relation to Brain and Nerve Diseases in the Light of the Most Recent Investigations.'

THE College of Physicians of Philadelphia announces through its committee that the sum of $500 will be awarded to the author of the best essay in competition for the first Nathan Lewis Hatfield prize for original research in medicine. The subject is 'A Pathological and Clinical Study of the Thymus Gland and its Relations,' and essays must be submitted on or before January 1, 1900.

THE examination for the position of Photographer in the U. S. Naval Observatory (salary, $1,200 per annum) has been postponed to June 23d. The examination will consist almost exclusively of experience and practical questions in photography.

DR. FRANK WALDO, of Princeton, New Jersey, offers elementary or advanced courses of lectures on meteorology to colleges and other educational institutions. Persons interested in the matter can obtain further details at the above address. Dr. Waldo was formerly a junior professor in the U. S. Signal service, and is the author of 'Modern Meteorology' in the Contemporary Science Series (London), and of 'Elementary Meteorology,' recently published by the American Book Company, in New York.

IT is reported in the daily press that President Jordan, of Stanford University, and a party of men of science are at present engaged in exploring the Grand Cañon of the Colorado and the 'Enchanted Mesa.'

MR. NIKOLAI HANSEN, a Norwegian zoologist, will accompany Mr. Borchgrevink in his approaching expedition to South Victoria Land.

IN addition to Lieutenant Peary's expedition to the Pole by way of North Greenland and Mr. Walter Wellman's by way of Franz Josef Land, the steamship Helgoland has just started from Germany for the Far North. The leader of this expedition, Herr Theodor Lerner, is accompanied by Dr. Brühl, Dr. Römer and Dr. Schaudien.

REUTER'S agency announces that Baron Toll, the well-known Arctic explorer, has submitted to the Imperial Russian Geographical Society a scheme for an expedition to explore Sannikoff Land, about which very little is known and the very existence of which is denied by some explorers. These include Dr. Nansen, who de-

clares that he failed to find traces of any land north of the New Siberian Islands. Baron Toll, however, is convinced that Sannikoff Land will be found in the place where it is indicated on the maps, and purposes to go thither with dogs and sledges and a portable house, and spend a year in exploration.

The Massachusetts House of Representatives has rejected, by a large majority, the bill reported by the Committee on Education appropriating $2,500 for the Boston Meeting of the American Association for the Advancement of Science.

The Thirty-third Field Meeting of the Appalachian Mountain Club will be held in the Adirondacks, beginning Friday, July 1st. A week will be spent at St. Hubert's Inn, after which those who desire to do so will have an opportunity to visit Lake Placid and other attractive resorts in this beautiful group of mountains. During the Field Meeting two evenings will be devoted to scientific and literary matters, and papers descriptive of the topography, geology, natural history and forestry of the region will be presented by authorities on these subjects.

The annual meeting and *conversazione* of the Selborne Society took place on May 30th in the rooms of the Society, Hanover-square, the President, Sir J. Lubbock, M.P., being in the chair. The objects of the Society are to preserve from unnecessary destruction such wild birds, animals and plants as are harmless, beautiful and rare ; to discourage the wearing and use for ornament of birds and their plumage, except when the birds are killed for food or reared for their plumage; to protect places and objects of antiquarian interest or natural beauty from ill-treatment or destruction, and to promote the study of natural history.

Natural Science finds that, under its new Curator, Mr. Alexander Gray, the Robertson Museum at the Millport Marine Biological Station continues to prove of service to naturalists and of interest to the public. Dr. Gemmill, lecturer on embryology, and Dr. Rankin, demonstrator in zoology, in Glasgow University, took several of their students to Millport during the Easter vacation ; and it is expected that many students from Glasgow University, as well as those attending other science classes in the neighborhood, will avail themselves, during the coming season, of the advantages offered by this institution for gaining a practical knowledge of the subject of their studies not otherwise attainable.

The Boston *Transcript* states that several interesting changes and additions are being made in the collections in the Mineralogical Museum and Laboratory at Harvard. The most important change in progress is the work of arranging some five hundred geological specimens, taken from different parts of the Museum and representing a large number of formations, so as to illustrate in detail the physical properties of minerals and also their mode of occurrence and associations with one another. The work is in charge of Messrs. Arthur S. Eakle and Charles Palache, instructors in the geological department. The collection will be contained in a series of twelve cases in the gallery near the entrance, and will form one of the most interesting features of the Museum. There is also to be placed on exhibition a large special collection of minerals to illustrate the occurrence of volcanic bombs. This collection was made by Dr. L. L. Hubbard, State Geologist of Michigan, in the vicinity of Lake Laach, Germany, and was presented by him to the Museum. Still another new feature of the Museum will be a collection of specimens of calcite from Lake Superior. The specimens contain some exceptionally fine crystals and illustrate to good advantage the occurrence of calcite crystallizing with copper.

The 23d meeting of the American Library Association will be held at Lakewood at Chautauqua, N. Y, from the 4th to the 9th of July. An interesting program will be presented, including an address by Mr. Herbert Putnam, of the Boston Public Library, President of the Society.

The New York Free Circulating Library opened its tenth branch at 215 East 34th street, on Monday last, June 6th. The library occupies the three upper floors of a former private residence that has been altered to suit its pur-

poses. On the main floor is a well-selected library of about 4,000 volumes, which is operated on the open-shelf system. In the rear are reading tables, and on the second floor is a small reference library and a reading room furnished with newspapers and magazines.

AMONG the books recently sold from the Ashburnham library was a copy of Pliny's 'Historia Naturalis,' lib. xxxvii., printed upon vellum by Jenson at Venice in 1472, for £190.

THE Macmillan Company announce the early publication of a book on 'Animal Intelligence' by Professor Wesley Mills, of McGill University. Dr. F. S. Hoffman, professor of philosophy in Union College, has in the press of Messrs. G. P. Putnam's Sons a work entitled 'The Sphere of Science.'

A RAILWAY to extend entirely across Northern Sweden and Norway from the north end of the Gulf of Finland, northwest to Ofoten, on the Atlantic about 120 miles north of the Arctic circle, is proposed. The line will be about 300 miles long, and will, it is said, be farther north than any part of the new railroad to Archangel.

AT the meeting of the Institute of Civil Engineers on April 5th, Mr. A. H. Preece gave an account of the present state of electricity supply in London. According to an abstract in *Nature*, Mr. Preece said that there are now in London eleven important companies and five vestries supplying electricity, and three other companies and three vestries are taking steps to start works. Five companies and three vestries supply the alternating current, and the remainder use direct-current systems. The direct-current systems are divisible into two classes—the high-pressure and the low-pressure. In the former rotary transformers are used to reduce the high pressure to a low pressure, while the latter produces and distributes electricity at the same pressure at which it is supplied to consumers. The direct-current systems are applicable to compact areas, and, with the use of high pressure, to scattered or isolated compact areas. The chief advantages of the direct-current system are the possibility of using storage-batteries, which can not be employed with the alternating-current systems, greater efficiency in distribution and greater adaptability to motive power. The favorite methods of distributing electricity are to transmit current at a high pressure in heavily-insulated cables in iron pipes, and current at a low pressure in insulated cable in stoneware conduits, or in cables heavily armoured and laid direct in the ground. Rubber is now little used; paper and jute, impregnated with insulating compounds, having been extensively adopted. The electric-supply industry is rapidly growing, and no less than 40,000 h.p. is now being installed in London in order to meet the demand for electricity in the immediate future.

FROM a statement compiled by Statistician Parker, of the United States Geological Survey, it is shown that the total output of coal in the United States in 1897 amounted approximately to 198,250,000 short tons, with an aggregate value of $198,100,000, a fraction less than $1 a ton. Compared with 1896, this shows an increase in tonnage of 6,270,000 tons. The increase in the value of the product was only $1,-700,000. The amount of coal produced in 1897 was the largest on record. The average value a ton was the lowest ever known, continuing the declining tendency which has been shown without any reaction.

VOLUME VI. of *Mineral Industry*, now in press, will show that the total value of the mineral production of the United States in 1897 was $746,230,982 (or, excluding duplication, $678,966,644), against $737,958,761 in 1896. The values given are generally at the mines or works; but with a few of the principal metals, such as lead, copper or zinc, this is not possible, and their values are taken at the leading markets. The total value of the output in 1896 exceeded that of the mineral and metal production of all Continental Europe, and nearly doubled that of the United Kingdom, the value of whose mineral output in 1896 was, in round figures, about $340,000,000, while that of Germany was about $300,000,000, that of France about $110,000,000, and that of Belgium $100-000,000.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. PHILIP D. ARMOUR has given an additional endowment fund of $500,000 to the Ar-

mour Institute of Technology, Chicago. He had previously given the Institute an endowment of $1,500,000.

MR. WASHINGTON DUKE has given $100,000 to Trinity College, Durham, N. C., which makes the total amount of his gifts to the College $425,000.

DR. D. K. PEARSONS, who has assisted so many smaller colleges, has offered to give the Salt Lake College, of Salt Lake, Utah, $50,000, on condition that its officers raise $100,000 more within a year.

DR. GEORGE W. HILL has been appointed lecturer in celestial mechanics in Columbia University, Miss Catherine W. Bruce having given $5,000 for this purpose.

PROFESSOR I. J. MACOMBER, of Cornell University, has been appointed professor of electrical engineering in the Armour Institute of Technology, Chicago.

DR. C. E. BESSEY, of the University of Nebraska, will give a course of fifteen lectures on botany in the Texas-Colorado Chautauqua, Boulder, Col., in July and August.

OF the twenty fellowships annually awarded at Johns Hopkins University, the following were in science: Joseph Scudder Chamberlain, of Ames, Ia., S.B., Iowa Agricultural College, 1890, *chemistry*; Percy Millard Dawson, of Montreal, Canada, A.B., Johns Hopkins University, 1894, and M.D., 1898, *physiology*; George Stronach Fraps, of Raleigh, N. C., S.B., North Carolina Agricultural College, 1896, *chemistry*; Leonidas Chalmers Glenn, of Crowder's Creek, N. C., A.B., University of South Carolina, 1891, *geology*; Caswell Grave, of Monrovia, Ind., S.B., Earlham College, 1895, *zoology*; George Oscar James, of Bowers Hill, Va., A.B., Johns Hopkins University, 1895, *mathematics*; Joseph Francis Merrill, of Richmond, Utah, S.B., University of Michigan, 1893, *physics*; Eugene Lindsay Opie, of Baltimore, A.B., Johns Hopkins University, 1893, and M.D., 1897, *pathology*; Frederick Albert Saunders, of Ottawa, Canada, A.B., University of Toronto, 1895, *physics*.

THE following are among the twenty-four University fellowships awarded in Columbia University: E. L. Firth, C. E., Cornell University, 1895; Columbia University, 1898, *sanitary engineering*; G. B. German, A.B., Columbia College, 1895, assistant in mathematics, 1895–98, *education*; E. Hagen, University of Vermont, 1897, Columbia University Scholar in Botany 1897–98, *botany*; O. B. Huntsman, A.B., Harvard University, 1897–98; *philosophy*; J. D. Irving, A.B., Columbia College 1896, Columbia University Fellow in Geology 1897–98, *geology*; E. Kasner, B.S., College of the City of New York 1896, A.M., Columbia University 1897, University Fellow in Mathematics 1897–98, *mathematics*; W. C. Kretz, A.B., Columbia College 1896, A.M., Columbia University 1897, University Scholar in Astronomy 1897–98, *astronomy*; J. W. Miller, Jr. B.S., Pennsylvania State College, 1897, *mechanics*; F. C. Paulmier, B.S., Princeton University 1894, M.S. 1896, Graduate Student at Columbia University 1896–98, *zoology*; F. J. Poyse, A.M., Queen's University, Kingstown, Canada 1898, Graduate Student at Columbia University 1897–98, *chemistry*; R. S. Woodworth, A.B., Amherst College, 1891; A.B., Harvard University 1896 and A.M. 1897; Assistant in the Physiological Laboratory of Harvard University 1897–98, *psychology*.

DISCUSSION AND CORRESPONDENCE.

COLOR VISION.

THERE are certain points in Mrs. Ladd Franklin's letter of June 3d that call for comment.

1. Mrs. Ladd Franklin sharply criticises me for having termed the Helmholtz theory a 'three-fibre' theory. The offence, if committed, would not be heinous. The phrase 'Dreifasertheorie' is current in German monographs, and is a convenient, if not strictly accurate, designation of the tricomponent theory. As a matter of fact, however, there is no single passage in my letter in which I characterize that theory as a three-fibre theory!

In mentioning von Kries' double-white process I added, in explanatory parenthesis, the words 'one-fibre white and three-fibre white.' I did this because I supposed that the lay reader might be troubled by the preceding phrase, and because I had found the terms valuable in my

lectures on optics, as shorthand names for the processes in question. Precisely the same terms have recently been coined by Hering and Hess (*Untersuchungen an total Farbenblinden*, Pfl. Arch., LXXI., Heft 3 and 4; March 25, 1898).

2. I spoke of Koenig's 'shift of excitability.' Mrs. Ladd Franklin rejoins that Helmholtz and Fick had a shift of excitability. Of course. If I had not known this from Hermann's *Handbuch* and the *Optik*, at least I should have known it from Mrs. Ladd Franklin's paper in Mind (N. S., II., p. 478; Oct., 1893), in which the facts are fully set forth. I wrote of Koenig's shift, and not Fick's, because it was Koenig's work, and not Fick's, that I wished to call attention to. I was referring to current theories, and had in mind the elaborate paper by Koenig and Dieterici, *Die Grundemfindungen in normalen und anomalen Farbensystemen und ihre Intensitätsvertheilung im Spektrum* (published in complete form in the *Zeitschrift*, IV., p. 241; 1893), and the pages in the *Optik* that rest upon the authors' experiments (2d ed., pp. 366 ff.).

3. On this basis—on the basis of a sheer misstatement, and of misapprehension of a position that should have been clear from the context—Mrs. Ladd Franklin charges me with concealing under an *ex cathedra* manner a 'rather unusual degree of ignorance.' The dogmatic manner of my previous letter I explained and apologized for: Professor Stevens accepted the apology in the spirit in which it was offered. As for the ignorance, the facts are these:

No professor of a total subject—physics or physiology or psychology—can keep adequately abreast of every line of work in his science in any given year. One has to 'keep up,' in a rough way, with most things, and to devote oneself in successive years to the detailed study of a succession of single things. This year has happened to be my optics year. I spent the summer vacation of 1897 and the spare time of the academic year 1897–8 upon optics. When Professor Stevens' letter appeared I felt that I was, perhaps, at the moment, better qualified than most of my colleagues to give him the bird's-eye view he asked for; it seemed to be a matter, if not of scientific duty, at least of scientific courtesy, to pen a brief statement in reply. Mrs. Ladd Franklin's sarcastic remarks about 'renewing my study,' etc., would apply, I take it, equally well—or badly—to every professor of every science in the country. Yet science manages to get on.

4. My position with regard to new theories is misrepresented by Mrs. Ladd Franklin. See my first letter, p. 605.

5. I said that Mrs. Ladd Franklin's theory had had 'grave experimental objection urged against it.' It was open to the author of the theory to call for proof of this statement. She has preferred to give it a flat denial. "There is no experimental evidence against my theory" (p. 775). Fortunately, the literature is still extant.

6. Mrs. Ladd Franklin concludes with an attack on the color theory of my *Outline of Psychology*. I would point out, in the first place, that my last chance for corrections was February 9, 1897 (see Preface to third ed.), whereas the last installment of Müller's paper is dated May 8, 1897. Should the book ever come to a fourth edition, Hering and Müller will be in it, unless the optical situation changes. Secondly, as regards the confusion of the theory, I did my best with the materials existing: I took Wundt's theory and, under the influence of Hillebrand's well known paper (*Ueber die specifische Helligkeit der Farben:* in the *Sitzungsber. d. k. Akad. d. Wiss. in Wien*, Feb., 1889), carried the brightness side of it to its logical conclusion. My position may have been over-cautious, over-sceptical; but I was trying to write a scientific book. I can see no ground for the charge of confusion.

I fear that the above remarks contribute nothing at all, directly, to science. I feel, however, that they should in justice be made, since Mrs. Ladd Franklin has been allowed to run amok through my previous letter. Indirectly they may be of service, if they show Mrs. Ladd Franklin that it is necessary to read before you criticise, and that there are amenities to be observed even in scientific controversy.*

E. B. TITCHENER.

*A small point, but typical. In the first five lines of p. 774 Mrs. Ladd Franklin manages to misquote me and to misname Hering's work. The *Zur Lehre* is a collection of six papers, and we have two specifically theoretical papers from the year 1874.

A PRECISE CRITERION OF SPECIES.

To the Editor of Science: Your note in Science No. 178 on the recent paper by Dr. Davenport and Mr. Blankinship on a 'Precise Criterion of Species' raises a question which I think you do not follow to its necessary conclusion. That the criterion of species is a problem largely made up of psychological elements seems an almost self-evident proposition, and as I understand the paper in question its object is simply to tabulate these psychological elements and draw from them an exact statement of accepted current usage. From this tabulation it appears that in America, during the present decade, groups of animals whose differences may be expressed by one kind of curve are currently regarded as species, while those whose differences give another curve are looked upon as subspecies. But why should the question be left here? If the curves were made from data furnished by determinations current in America during the past decade or in Europe now they would be strikingly different from those actually obtained by Dr. Davenport. An almost equally noticeable discrepancy would occur between the curves furnished by the work of certain American and European systematists at the present day as compared with those of some of their respective compatriots.* Furthermore every individual worker passes through phases of opinion in each of which his work would give appreciably different curves. It appears to me, therefore, that Dr. Davenport and Mr. Blankinship have elaborated not so much a precise method of distinguishing between species and sub-species as for graphically representing the opinions of different times and individuals. In other words, they have shown how to make a Linnæus-curve, a Brehm-curve, an America-curve or an 1898-curve—which when compared together have an undoubted psychological interest—but they have not furnished a criterion which will be of actual service to working systematic zoologists. The reason for this failure is partly, as Dr. Davenport suggests in his letter in Science No. 179, due to the complexity of the method, but more especially to the fact that systematists, from the very nature of their work, must hold themselves ever ready to accept new points of view and new standards of value.

* I write from the standpoint of mammalogy and ornithology.

Gerrit S. Miller, Jr.

U. S. National Museum.

SCIENTIFIC LITERATURE.

A Text-book of Entomology, including the Anatomy, Physiology, Embryology and Metamorphoses of Insects, for use in Agricultural and Technical Schools and Colleges, as well as by the working Entomologist. A. S. Packard. Macmillan Company. 1898. 8vo. Pp. 729. 654 figs.

Students of entomology who began their work some fifteen or twenty years ago often found Professor Packard's 'Guide to the Study of Insects' the only accessible American book of reference on the subject of general entomology. It was a large volume, containing much valuable material, but it never seemed to satisfy one even on minor questions. It contained anatomy, physiology, embryology and taxonomy in a somewhat undifferentiated condition. The redeeming feature of the work was the wide philosophical interest that its pages inspired. This interest had its source in Professor Packard's own industrious and enthusiastic study of the subject of entomology, a study which he has extended without interruption during the thirty years that have elapsed since the publication of the 'Guide.' The results of this long study now lie before us in this able text-book.

The recent publication of Comstock's 'Manual' and Sharp's volume on insects in the 'Cambridge Natural History' has evidently led Professor Packard to exclude a consideration of the taxonomy of insects and to confine his treatment to the morphological and physiological aspects of the subject—a task surely very great even as thus limited. He takes up in succession the anatomy, embryology and metamorphoses of insects, giving more or less attention to the physiological aspect as he proceeds. His presentation of this last aspect is, perhaps, the weakest portion of the book, because Professor Packard has not made special up-to-date studies in this field. He omits all mention of several interesting physiological facts, such as Professor J. Loeb's interesting experiments on the heliotropism and stereotropism of insects.

He moves somewhat more securely over the ground of histology and embryology, although we find an occasional lapsus or deficiency. As an example of a histological lapsus Professor Packard's account of the origin of the tænidia of the tracheæ (p. 449) may be mentioned. He describes the spiral thread of the chitinous trachea as originating from nuclei (!) and gives two figures to illustrate this remarkable contention. But if these figures show anything they show that the tænidia arise from the cytoplasm of the tracheal hypodermis and not from nuclei.

The embryologist may object to Professor Packard's heading a section (p. 126) with the words 'Embryonic development of the wings.' In accepting Weismann's observations, published in 1864, that the imaginal discs of the legs and wings of the blow-fly are formed before the hatching of the embryo, Professor Packard does not stop to consider that these observations were necessarily unsatisfactory because the method of sectioning the egg was not in vogue at the time. Moreover, an examination of the concluding paragraphs of Graber's study of the embryology of the fly (1889) and of the accompanying figures of sections would have convinced Professor Packard of the uncertainty of the statement that the wing-germs are formed in the embryo, and he would have avoided a misleading heading. Several cases of a similar incautious haste in accepting the statements of authors could be pointed out.

On the whole the complicated subject of insect morphology is handled with a good sense of proportion. We could have wished for longer chapters and more instructive figures illustrating the fascinating subjects of phosphorescence, stridulating organs, compound eyes, etc. Stridulating organs are not even figured. The vast literature on the compound eyes of insects must surely furnish much better figures than those employed by Professor Packard, and a few good sections of one of our common fireflies would furnish better drawings of the phosphorescent organs than the one taken from Emery's paper.

In the embryological division of the subject there are many little inaccuracies, as *e. g.* (p. 525) when Professor Packard says: "The germinal vesicle of the ripe insect egg lies in the center of the yolk, where it appears as a large vesicle-like cell-nucleus containing a few chromatine elements." If Professor Packard had ever spent hours, days, or even weeks, searching for the germinal vesicle in a ripe insect egg, he would not describe it as a 'large vesicle-like' structure in 'the center of the yolk.' The envelope formation and revolution of the insect egg admits of a more interesting comparative treatment than that employed by Professor Packard. In this connection we venture to say that the inversion of the figures of the *Œcanthus* embryo (p. 545), taken from Ayers, will only serve to perpetuate an unfortunate blunder in the orientation of the embryo with respect to the egg.

It is to be regretted that Professor Packard could not omit all reference to Neo-Lamarckianism. In the closing paragraph of the portion on insect metamorphosis we find the following sentence: "The sudden or tachygenic appearance of temporary structures, such as hatching spines, various setæ, spines, respiratory organs, so characteristic of dipterous larvæ and of the protective colors and markings of caterpillars and which are discarded at pupation or imagination, are evidently due to the action of stimuli from without, to the primary neolamarckian factors, the characters proper to each larval stadium and to the pupal and imaginal stadia, characters probably acquired during the lifetime of the individual, becoming finally fixed by homochronous heredity." Such language is out of place in a text-book, unless the other side of the question is also presented. In certain respects insect metamorphosis is one of the least favorable subjects for the study of the 'primary Neo-Lamarckian factors.' The Neo-Lamarckians have yet to demonstrate how, *e. g.*, many chitinous structures, such as hairs, scales, etc., which are really *dead* or fixed before they begin to function in the imago, and which have certainly undergone specific or even generic variation since complete metaphosis was acquired in the common ancestor, can be due to the direct action of external stimuli becoming finally 'fixed by homochronous heredity.'

It would be possible to cite several cases of inaccuracy in Professor Packard's book, were

it not more important to commend the great labor which he has bestowed upon it, than to search for the little errors that are unavoidable in every attempt to cover a field extending so far beyond the possible limits of any one entomologist's experience. Our critical inclination gives way to our gratitude to Professor Packard for having accomplished so well what very few would have the courage to undertake, and fewer still the ability and preparation to execute. With the books of Professors Packard, Comstock and Sharp on his shelves, the beginning entomologist of to-day will find before him a short and pleasant path to a knowledge of his subject instead of the long and tortuous course which many American entomologists have had to pursue. With these works the 'modern morphologist,' who is often not a little proud of knowing nothing about Hexapods, can fill a gap in his library, if not in his information. The wide-awake morphologist or physiologist who turns the pages of these works will see suggestions of many great problems and of greater opportunities for work than he may be able to find in the more limited and more nearly exhausted fields of annelid and vertebrate morphology. Insects have been long and lovingly studied, but we have scarcely begun to know more than a few superficial facts concerning them. Professor Packard's book, we venture to predict, will, in the course of time, attract many American students to the study of the intricate organization and development of insects and thereby lead indirectly but surely to an increase of our knowledge.

William Morton Wheeler.

Pasteur. By Percy Frankland and Mrs. Percy Frankland. New York, The Macmillan Company. 1898. Pp. 224. Price, $1.25.

Of few men of science can it be said more truly than of Pasteur that the story of his life is found in his work. Judged by ordinary standards his life itself was not an eventful one, and the simple record of his scientific achievements constitutes perforce the larger part of any biography. In order to understand what significance these achievements possessed for Pasteur's contemporaries and what they mean to his successors it is necessary to correlate the discoveries made by Pasteur both with the condition of science in his time and with our present knowledge, and the deftness with which such a relation is traced becomes a fair measure of the biographer's success. For this task the present biographers are unusually well equipped, and they have approached the subject with an appreciation of the simplicity of the man and the dignity of his undertakings that has given us a most readable account of the life-work of the great master.

Louis Pasteur was born at Dôle on the 27th of December, 1822, and was of humble origin, his father being the owner of a small tannery. By dint of great sacrifices on the part of his parents, Louis was given early opportunities for study, and the boy soon attracted the attention of his teachers through his great diligence, energy and enthusiasm. When he was twenty-one years of age he went up to Paris to the École Normale and threw himself almost at once into the work of investigation. He fell first under the influence of Biot and began that study of the crystals of tartaric acid which led to the remarkable discovery of the spatial relations subsisting between the atoms within the molecule and blazed the way for the fruitful generalizations of stereo-chemistry.

M. Duclaux, in his admirable book, 'Pasteur: Histoire d'un Esprit,' has recently grouped Pasteur's researches under eight heads: Studies in Crystallography, The Lactic and Alcoholic Fermentations, Spontaneous Generation, Researches upon the Diseases of Wine and Vinegar, The Silkworm Disease, Studies on Beer, The Etiology of Infectious Diseases and Researches upon Vaccines, and our authors have in the main followed this grouping. It may be doubted if the history of science offers a better illustration of the way in which scientific research carries a worker irresistibly along on its own current, sometimes rendering him a foiled, circuitous wanderer, sometimes, as with Pasteur, leading from one channel into another with the horizon always widening out as the water deepens around him.

That perennially interesting subject, Pasteur's controversy with Liebig over the theory of fermentation and decay, is treated by our

authors in a thoroughly judicial way, although with a bias towards Pasteur's main contention perhaps unavoidable in the light of our present knowledge. "Those who attempt to explain the putrefaction of animal substances by animalcules," wrote Liebig, "argue much in the same way as a child who imagines he can explain the rapidity of flow of the river Rhine by attributing it to the violent agitations caused by the numerous water-wheels of Mainz, in the neighborhood of Bingen." Liebig, as is well known, was soon forced to retreat from the position that the alcoholic fermentation is due not to the activity of the living yeast plant, but to the decomposition of the nitrogenous components, and was obliged to yield to the overwhelming evidence adduced by Pasteur in support of the view that not the dead or the dying, but the live yeast-cell was responsible for the phenomenon. Liebig later acknowledged defeat so far as to admit the share of the live yeast plant in the process, but still clung tenaciously to his hypothesis of a transmission of molecular vibration, itself a modification of the view long before advanced by Willis and Stahl, while Pasteur advocated with equal tenacity the view that the yeast plant simply breathes at the expense of the oxygen of the sugar molecule. The recent discovery by E. Buchner of an alcohol-generating enzyme in the fluid pressed out of pulverized yeast-cells—a discovery, by the way, sadly in need of confirmation—can hardly be said to conclude the controversy, although bringing us to somewhat closer quarters with the real problem.

Pasteur's memorable researches upon anthrax are described at some length and in a very interesting fashion, although with an exaggeration of the hero's rôle as compared with that of Koch and others, which is perhaps more pardonable in a biographer than it would be in an historian of science. There are not lacking some other instances of unnecessary magnification of Pasteur's achievements—although one is tempted to ask oneself if they can ever really be made to bulk too large—and of French bacteriology in general. Is it quite correct, for instance, to mention Calmette's work upon the production of immunity towards abrin (p. 197) in such a way as to convey the impression that he was the pioneer in this work? Despite some blemishes of this sort, however, and despite, too, an excess of divided infinitives and a profusion of bellicose metaphors, this biography presents a just and interesting account of the life of a great man.

The closing chapters of the book contain a vivid and picturesque description of the master's methods of work, of his founding of the Institut Pasteur, of his work on rabies and of his last years. In simplicity of life and in the patience, persistence and fire that mark the genius, Pasteur stands as one of the shining figures in the science of the century. "He makes me uneasy," said one of his early friends; "he does not recognize the limits of science; he loves only quite insoluble problems." At the dedication, on November 14, 1888, of the great institution that bears his name, Pasteur himself gave a bit of his inmost life. "This that I ask of you is what you again, in your turn, will demand of the disciples who gather round you, and for the investigator it is the hardest ordeal which he can be asked to face, to believe that he has discovered a great scientific truth, to be possessed with a feverish desire to make it known and yet to impose silence on himself for days, for weeks, sometimes for years, whilst striving to destroy those very conclusions and only permitting himself to proclaim his discovery when all the adverse hypotheses have been exhausted." Yes, that is a difficult task.

"But when, after many trials, you have at length succeeded in dissipating every doubt, the human soul experiences one of the greatest joys of which it is capable."

EDWIN O. JORDAN.
UNIVERSITY OF CHICAGO.

A College Course of Laboratory Experiments in General Physics: By SAMUEL W. STRATTON and ROBERT A. MILLIKAN. Chicago, The University of Chicago Press. 1898. Pp. 100.

In a recent issue of SCIENCE a writer whose specialty is chemistry refers to the following remark in which he had indulged: "There is small doubt that, were it not for the expense of printing, every teacher of chemistry would use a text-book made by himself with either pen

or scissors." A foreign critic's comment upon this was : "Sad, indeed, if true!"

Most teachers of science who have laboratories to control, whether in chemistry, physics or biology, will probably be ready to express their accordance with the view of the chemical writer. No one can direct students in a physical laboratory without finding that his own needs are not met in any one of the considerable number of laboratory guide books with which the market now abounds. Nor would he be any more fortunate if the number of these became tenfold greater. No two laboratories are alike; no two teachers are alike. Every laboratory manual is a compound product of teacher, laboratory and special circumstances. It is never made deliberately for the purpose of instructing the world at large, but specially for one laboratory in particular. It is then published, in the hope that its contents may be useful in other laboratories.

The earliest laboratory manual for students in physics, that of Kohlrausch, was written so concisely that, while apparently as good for one laboratory as for another, it was found by its users to be always in need of supplementary matter. Each instructor usually prepares special cards with such directions as are found needful under given conditions of use. The instructor must in any case be within reach to respond to the student's needs; but there is great saving of time, breath and patience if everything is plainly written or printed that can be reasonably demanded by a student of ordinary ability. Laboratory work is far superior to class work in revealing the possession or absence of that power of quick discernment and practicality which is colloquially called 'gumption.' The student who is naturally blessed with this power needs but little more than the instruction cards, but there are always some who cannot be kept from blundering even if the instructor is continually present. These are the ones that sap his energies; and in self-defense he is often compelled to adapt his cards to them, giving specific directions adjusted to the particular apparatus to be employed, anticipating the mistakes they will make, and sacrificing educative aims to the need of saving apparatus from injury.

Since the primary function of a laboratory manual is thus to save time and labor for both instructor and student, it follows almost as a necessity that each laboratory must be provided with its own manual. If this be printed, convenience is temporarily promoted. But each year brings changes. Old cards must be modified or new ones written, or the laboratory manual must be subjected to frequent revision. Manuals prepared for other laboratories must, it is true, be at hand for ready reference. They are highly useful, but never sufficient, because not adapted to the particular apparatus which the student is called upon to master.

The small volume of a hundred pages by Messrs. Stratton and Millikan is an excellent index of the good work through which junior students are carried in the Ryerson laboratory, of the University of Chicago. It bears much internal evidence that its authors were writing specifically for their own students, and writing with a degree of intelligence that indicates how successful their work must be. The book opens with some general directions regarding the method of making observations, keeping records of these, and estimating the accuracy attainable under given conditions of work. The exercises are grouped under three heads, Mechanics, Molecular Physics and Physics of the Ether. Under the former are included various methods of measuring distance, direct and indirect determinations of the acceleration of gravity, an excellent discussion of the use of the balance, the determination of density for solids and fluids, elasticity of tension and torsion, composition and resolution of forces, the ballistic pendulum, work and efficiency. The instructions are for the most part given very clearly, and in each case followed by a form of record with blanks to be filled in by the student. The last feature may at first seem a little procrustean, but the value of such specific guides is best appreciated by those who have had most experience in the wearisome work of examining report books.

Under the head of Molecular Physics are considered the surface tension of liquids, the properties of gases, hygrometry, thermometry, coefficients of expansion, specific heat, energy of fusion and vaporization, and methods of determining the velocity of sound.

Under the head of Physics of the Ether are considered the constants of mirrors and lenses, the combinations of these to form telescopes and microscopes, the spectrometer and spectrum analysis, magnetic and electric fields of force, absolute measurements of electric current, quantity, potential difference and resistance, battery electromotive forces and resistances, the use of galvanometers, the absolute determination of capacity and comparison of capacities, electro-magnetic induction, efficiency curves for incandescent lamps, thermo-electric power, and radiation.

On the assumption that such a course should be progressive in difficulty, the last parts require decidedly greater proficiency on the part of the student. Many juniors will find it necessary to read with special care the theoretic discussion of capacity. In the exercise on radiation Boys' radiomicrometer is employed in place of thermopile and galvanometer.

The book closes with a few tables of constants, of natural functions and of logarithms.

Upon the whole, this volume is a welcome addition to the literature of the subject. Apart from some obvious typographical errors, it may be consulted with confidence in the accuracy of its statements. While many other laboratories are less generously equipped than the Ryerson physical laboratory, and therefore cannot substitute this book for local instruction cards, it contains so much of good suggestion and is so well methodized that many instructors will surely utilize it in the improvement of the instructions which they prepare for their own students.

W. LE CONTE STEVENS.

SCIENTIFIC JOURNALS.

THE *American Naturalist* for April, which has just been received, opens with an article on the Sarcostyles of the *Plumularidæ*, by Professor C. C. Nutting, followed by the third chapter of the work on the wings of insects, by Professor J. H. Comstock and Mr. J. G. Needham. The present chapter treats of the specialization of wings by reduction and is illustrated by twenty-three cuts. There are briefer articles as follows: 'A Case of Variation in the Number of Ambulacral Systems of *Arbacia punctulata*, by H. L. Osborn; 'Relationship of the Chriacidæ to the Primates,' by Charles Earle; 'Further Notes on Thermometer Crickets,' by C. A. Bessey and E. A. Bessey; 'Pollination of the Closed Gentian by Bumblebees,' by R. J. Webb.

Popular Astronomy for June opens with an article on 'Scales of Seeing,' by Mr. A. E. Douglass, of the Lowell Observatory, in which he discusses a standard scale which he hopes will be generally adopted and used for comparison. There are articles by Dr. Herman S. Davis on women astronomers and Orrin C. Harmon on the astronomy of Shakespeare, and short articles by Messrs. E. J. Wilczyuski, J. A. Parkhurst and the editors, Professor W. W. Payne and Mr. H. C. Wilson.

A NEW journal of interest to students of agricultural science, entitled *Revue des Hybrides Franco-Americains*, has been published since January of this year by M. P. Gouy, Vals près Aubenas.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 486th meeting of the Philosophical Society was held at 8 p. m., May 28th, at the Cosmos Club. Two biographical sketches were read before the regular exercises for the evening. The first was of Mr. C. H. Kümmel by Mr. Marcus Baker, the second of Mr. Orlando M. Poe by Mr. O. H. Tittmann. The first scientific paper was by Mr. Louis A. Fischer, who described and illustrated in a general way the methods for comparing 'line' with 'end' standards. He also described in detail a special method for comparing such standards depending upon small auxiliary abutting pieces, the principal features of which are that they are very light and that the lines ruled upon them are so close to abutting surfaces (about 0.8 mm.) that the distance between the lines when the pieces are in contact with one another may be measured with the micrometer screw of any ordinary microscope. He called attention to the fact that certain systematic errors amounting to one part in 300,000 were discovered in the lengths of bars determined by the Fizean, or reflection, method at the International Bureau of Weights and Measures. This method was used

to determine the relation of the present International Metre to the old metre of the archives; and, therefore, the assumption heretofore made that these two bars are identical in length can no longer be accepted.

The second paper was by Mr. A. Lindenkohl, the substance of which was as follows: Recent hydrographic surveys off Montauk Point and off the southern coast of the New England States furnish more exact information concerning the submerged terminal moraines of those regions than preceding ones. The shoal ground which, in the shape of a horseshoe, stretches from Martha's Vineyard to Block Island, is believed to be of glacial origin, and shows that the moraine was laid down on a very uneven floor, and that here the ice sheet pushed out into the sea to a greater distance and depth than elsewhere in the vicinity. A 'drowned' river channel breaking through this shoal ground indicates a subsidence of about 150 feet. The shoal ground between Block Island and Long Island has several dangerous rocky heads; their existence was not suspected until, in 1862, the steamship 'Great Eastern' struck on one of them, since called 'Great Eastern Rock.' About half way between the two islands we meet another sunken river channel, giving evidence of a subsidence of about 130 feet. The moraine which is represented by Cape Cod and the Elizabeth Islands does not appear to terminate at Cuttyhunk, but to extend farther to the southwest, including Brown's shoal, and to connect with the one on the mainland by successive steps, forming barriers across the entrance of Buzzard's Bay, which are pierced by a channel 120 feet deep. This channel points to a sinking of the land of about 80 feet. The subsidence of 150 feet furnishes an estimate of the highest level attained by the land since the glacial period, and those of 130 and 80 feet, respectively, to indicate transitory levels during a period of gradual subsidence.

E. D. Preston,
Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

May 24. Mr. Charles Morris, under the auspices of the Anthropological Section, read a paper on the antiquity of man from the standpoint of evolution.

The carnivorous tendencies of certain monkeys were considered by Messrs. Dixon and Morris.

May 31. Professor H. A. Pilsbry exhibited a fine collection of mollusca from South Australia, presented to the Academy by Mr. Bednall, of Adelaide. They nearly complete the Academy's collection of shells from that region. The mollusca, and probably the other invertebrates of South Australia, are not at all archaic, and do not represent the fauna of an earlier geological period as do the higher orders.

Professor B. Sharp called attention to a specimen of *Ibacus Peronii* from South Australia, other examples of the same decapod being from China, thus illustrating an important extension of geographical range. The second antennæ, the auditory function of which was dwelt on, are curiously flattened and extended laterally, instead of being lengthened, as is usually the case. The strong spines of the species resemble those of *Palinurus* and are probably of similar protective value. A species of *Pseudosquilla* in the collection from the same region is common to the tropical Pacific.

A paper entitled 'Botanical Observations on Mexican Flora, especially on the Flora of the Valley of Mexico,' by J. W. Harshberger, M.D., was presented for publication.

Edw. J. Nolan,
Recording Secretary.

NEW BOOKS.

L'Année philosophique, publiée sous la directions de F. Pillon. Paris, Alcan. 1898. Pp. 312.

Introduction to Algebra for the use of Secondary Schools and Technical Colleges. G. Chrystal. London, Adam and Charles Black; New York, The Macmillan Company. 1898. Pp. xviii +412+xxv. $1.25.

La fatigue intellectuelle. A Binet et V. Henre. Paris, Schleicher Frères. 1898. Pp. 338.

Industrial Electricity. Translated and adapted from the French of Henry de Graffigny by A. G. Elliott, B.Sc. London, Whittaker & Co.; New York, The Macmillan Company. 1898. Pp. 152. 75 cents.

SCIENCE

FRIDAY, JUNE 24, 1898.

CONTENTS:

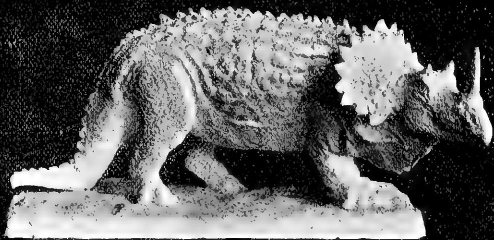
MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*MODELS OF EXTINCT VERTEBRATES.**

THERE are certain obligations resting upon the curators of metropolitan museums from which curators of university museums should enjoy a grateful immunity. These mainly involve the difficult undertaking of arousing interest and spreading accurate information among a very large class of inquisitive but wholly uninformed people. If these obligations are unfulfilled the metropolitan museum fails in its purpose and deserves the withdrawal of public support.

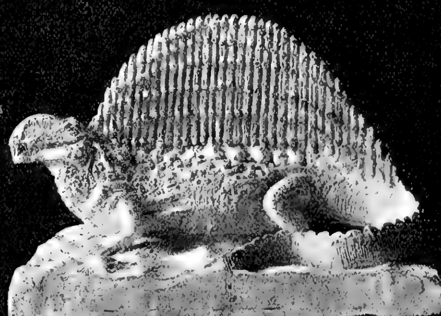
With this general idea in mind, members of the Department of Vertebrate Paleontology at the American Museum have been making a special study of all the legitimate methods of attracting the attention and interest of visitors. Among these methods are the series of water-color restorations of extinct vertebrates, executed by the animal painter, Mr. Charles Knight, with the aid of various scientific suggestions and criticisms. The preparation of these drawings involves a far more careful preliminary study than would generally be supposed. The artist begins by making a number of models in wax, based upon the actual proportions and muscular indications of the skeleton, and by

*Catalogue of Casts, Models, Photographs and Restorations of Fossil Vertebrates, issued by the Department of Vertebrate Paleontology, American Museum of Natural History, April, 1898.



No. 1. Agathaumus sphenocerus *Cope.*

No. 2. Hadrosaurus mirabilis *Leidy.*



No. 4. Naosaurus claviger *Cope.*

No. 3. Megalosaurus (Lælaps, Dryptosaurus) aquilunguis (*Cope*).

a series of preliminary anatomical studies representing different attitudes and feeding habits. Thus in the restoration of an extinct animal the proportions and positions of all the joints and angles of the feet and limbs may be made true to life. The lips, nostrils and gape of the mouth are determined by comparison of the length of the nasals, size of the anterior nares, character and position of the teeth, with similar parts in the most nearly related forms. The eyes are carefully located and proportioned. Up

to this point the animal may be considered a fairly correct representation of the original. On the other hand, the shape of the ears, the color and epidermic characters are largely imaginative, except in so far as they are suggested by relationship to modern allies, as in the case of horses, tapirs, rhinoceroses and other forms.

Out of the necessity of giving the restorations a complete and natural artistic relief, the wax models have been made with increasing care, and it finally occurred to the writer that, with a little more elaboration, the models themselves might be made well worthy of preservation in plaster form, first finished in wax and then cast from a carefully prepared plaster model, as represented in the accompanying photographs.

The frilled Dinosaur, *Agathaumus sphenocerus*, Cope, is based upon a prior restoration, published by Professor O. C. Marsh, of his *Triceratops prorsus*, this genus and species being distinguished from *Triceratops* by the large anterior median horn and the small posterior paired horns. As well known from Professor Marsh's descriptions and restorations, these Dinosaurs were great herbivorous quadrupeds, with fore and hind limbs more symmetrically developed than in any other members of this sub-class, the total length of the skeleton being about 25 feet. In addition to the powerful horns the skull is protected by a great bony collar or frill, which is surrounded by heavily barbed tubercles. The tubercular character also given by Mr. Knight to the epidermis is conjectural.

The form of the second type, *Hadrosaurus mirabilis*, Leidy, is quite as fully known, as it rests upon the remarkably complete skeleton in the Cope collection, found in 1882 by Dr. J. L. Wortman in the Laramie Cretaceous, and described by Professor Cope under the generic name *Diclonius*. This animal was thirty-eight feet in length, with a long neck, flattened duck-like bill, weak teeth, small fore limbs and heavy hind limbs, the body terminating in an elongated tail. It was probably of littoral habits, feeding on soft water-plants or small mud-loving organisms.

The third type, *Megalosaurus aquilunguis*, Cope (Laelaps), is the most extreme example of a highly conjectural restoration. It embodies the original ideas of Cope upon this subject, that these carnivorous Dinosaurs were capable of leaping through the air. The restoration is based upon the fragmentary skeletons in the Cope collection, and upon Professor Marsh's restoration of the allied form, *Ceratosaurus*. The skeleton was light, partly pneumatic. This species was about seven feet in length of trunk and neck, and had eight feet of tail. The disproportionately long hindlimbs and heavy tail remind one of the Kangaroo, which animal it may have resembled, both in its method of progression by leaps instead of by walking or pacing and in using its powerful hind feet, armed with heavy claws, in attacking its enemies.

A most picturesque form is the *Naosaurus claviger*, Cope, which, although of the most extreme appearance, is probably nearer the truth than any one of the foregoing models. The enormous spines upon the back are not in the least exaggerated, since the spines of *Naosaurus* collected by Dr. E. C. Case for the University of Chicago are even longer than those in the Cope collection. The skull in the Cope and in the University of Chicago collections is also sufficiently perfect to assure us of the substantial fidelity of this region. The limbs and tail are lizard-like. The different species of *Naosaurus* reached from three to ten feet in length. The precise function of the extraordinary, rigid fin on the back is not known. It was humorously suggested by Cope that in *N. claviger*, in which the dorsal spines present a series of cross-bars, the fin may have been

used as a sail; it was quite as probably ornamental as protective. This animal belongs to the primitive reptilian order, Pelycosauria of Cope, but it represented a highly specialized side-branch related to the Rhynchocephalia or Proganosauria, as shown by Baur and Case.

Interest in the above series of four is enhanced by the fact that Professor Cope, shortly before his death, gave Mr. Knight the benefit of many criticisms and ingenious suggestions.

The latest of this model series is taken from the remarkable skeleton of *Cervalces americanus*, in the Princeton Geological Museum. It is upon a larger scale than the preceding, and represents the animal as Scott has described it, namely, intermediate in form between the Moose and Elk, so far as proportions of the body and the shape of the head are concerned.

Other models are in preparation, and the series of water-color restorations, which now numbers nineteen, is progressing as fast as the complete skeletons are procured and prepared, serving as a basis for anatomical study.

HENRY F. OSBORN.

FIG. 1.—Powell County Natural Bridge.

NATURAL ARCHES OF KENTUCKY.

ALONG the western margin of the Eastern Coal Field in Kentucky are a number of 'Natural Bridges,' which it seems to me cannot be explained in any of the ways yet suggested. They have not been formed by the falling in of the roofs of underground streams, by wind erosion, or yet again in the manner presented by the contribution on this subject in the May 20th number of

Science, *i. e.*, by the mechanical action of frost on sandstones exhibiting a tendency to conchoidal fracture.

These natural bridges occur in the strip of very rough country formed by the outcrop of the Basal Coal Measure Conglomerate, where it is underlaid first by shale and then by lower Carboniferous limestone and shaly sandstone. This strip is a part of a deeply multi-dissected plateau, known farther south as the Cumberland Plateau. The tributary streams, deeply buried below the old plateau level, have along the margins of the strip cut down into the underlying shale, limestone and shaly sandstone. They have extended their ramifications up the steep slopes to the base of the Conglomerate, where they have hollowed out their virtual sources in the shale, undermined the Conglomerate cliffs and thus formed vast amphitheaters, or 'rock-houses.' The extent of these is often seemingly out of all proportion to the size of the stream leading away from them. These streams sometimes find continuation above the cliffs as wet-weather streamlets and during the times of their flow plunge over the escarpments in picturesque waterfalls. More commonly, however, there is no gathering ground above. By the recession of sources the watersheds have been reduced to the narrowest ridges, which are often quite inaccessible. In a number of instances two streams in their recession have met in the shales under the Conglomerate. Two 'rock-houses' have met back to back and formed a 'Natural Bridge.' There are three of these bridges in Kentucky that are beginning to have something more than a local celebrity. One of these is in Pulaski, one in Wolfe and one in Powell county. Views of the Powell county bridge accompany this sketch. Perhaps a tendency to conchoidal fracture in the coarse sandstone has favored the hollowing-out process that has resulted in these natural arches, but in the main they are due to the mechanical action of water causing a recession of sources in the way above indicated.

Arthur M. Miller.
State College, Lexington, Ky.

THE INTERNATIONAL AËRONAUTICAL CONFERENCE AT STRASSBURG.

The meeting, ten weeks ago, of the International Aëronautical Committee appointed by the Paris Meteorological Conference of 1896 was noteworthy in two respects. First, it marked the beginning of a new era in meteorological investigation, as shown by an organized effort to cut loose from observatories on the earth and to study the conditions of the free air; and, second, by the assembling at Strassburg of French and Germans, political questions were held to be subservient to the conquest of the high atmosphere and the extension of the common realm of science. Official and private hospitality was abundant and the utmost good fellowship prevailed among the members of the Committee and the other meteorologists, physicists and aëronauts who were present by invitation. It was regretted, although hardly a surprise, that there was no one from Great Britain, where, since Glaisher's remarkable balloon ascension, little has been done to explore the free air. The following named members of the Committee were in attendance: Professor Hergesell, the President, of Strassburg; MM. de Fonvielle, the Secretary, Cailletet and Besançon, of Paris; Drs. Assmann and Berson, of Berlin; Professor Erk, of Munich; General-Major Rykatcheff and Colonel Kowanko, of St. Petersburg; Mr. Rotch, of Boston, United States.

The methods discussed for obtaining observations in the free air were balloons with aëronauts; *ballons-sondes*, or unmanned balloons to carry self-recording instruments to the height of ten miles or more; and,

for observations within a mile or two of the earth, the captive kite-balloon and kites with self-recording instruments. Aside from technical details, the most important decisions concerning balloons related to the measurements of their height and of the air temperature around them. Although, for the determination of height, from observations in the balloon, the mercurial barometer must be considered as the standard, yet its indications are only accurate when the balloon has no vertical velocity. If aneroids are used they should be compared frequently with the standard and, so far as possible, under actual conditions. It was decided that for the calculation of height the barometric observations should be reduced everywhere by the same method, whatever that might be ultimately. M. Cailletet described his apparatus for photographing automatically, at fixed intervals of time, a barometer in the balloon and the ground vertically below, so that the barometric heights can be calculated and from a map the true heights and the route of the balloon may be determined. This apparatus was recommended for use with both manned and unmanned balloons. On account of the rapid changes of temperature, it was recognized that very sensitive thermometers must be employed in *ballons-sondes* and that their artificial ventilation is essential. M. Cailletet exhibited a thermometer having a spiral silver tube for its bulb soldered to a glass tube, both being filled with the liquid toluene. This thermometer is extremely sensitive. M. Teisserenc de Bort showed a very sensitive self-recording thermometer which is at the same time almost insensible to shocks. It is composed of a blade of German silver set in a frame of invariable steel, and can be ventilated in a *ballon-sonde* by a fan turned by a weight attached to a long wire. For the determination of the temperature of the air around manned balloons the proper instrument to employ is Assmann's aspiration thermometer, hung at least 5 feet outside the basket, but simultaneous comparisons with the sling thermometer were advised. The self-recording instruments carried in manned and unmanned balloons should be verified in pneumatic and refrigerating cabinets under such changes of pressure and temperature as might occur in the atmosphere.

Drs. Hergesell and Berson urged the importance of simultaneous balloon ascents in the different countries when there was a barometric depression over the European continent. From a meteorological standpoint the manned ascents have an importance which the *ballons-sondes* do not possess, because the temperature of the highest atmosphere has no influence on the meteorological elements near the surface of the earth. M. de Fonvielle, however, called attention to the interest which thermometric measurements at a very high altitude would offer for the determination of the temperature of planetary space. These measures might enable us to choose between the kinetic theory of gases, which assumes the temperature of 273° Centigrade below zero, and Fourier's hypothesis that the temperature of space is near that of the minima observed in the polar regions of the earth.

It was agreed that the fifth international ascent of *ballons-sondes* should take place early in June, and manned or unmanned ascents were promised in Austria, Belgium and Italy, in addition to those in Germany, France and Russia, which countries had already cooperated. On the day designated, observations at the mountain stations, as well as with kites and captive balloons, will serve for the simultaneous study of the lower air.

Mr. Rotch read a report, which he had been asked to prepare, on the use of kites for meteorological observations, based on the experiments carried on at Blue Hill Ob-

servatory for several years past. The advantages which kites have over balloons up to a height of at least 10,000 feet, whenever there is wind, were pointed out. It was reported that, besides their use in the United States, kites were being employed to obtain meteorological records at St. Petersburg and near Paris. M. Tacchini proposes to try them on Mounts Cimone and Etna, and Professor Hann hopes to obtain data in this way above the Sonnblick, the highest permanently occupied observatory in Europe. The Conference recommended kites as being of great value to meteorology, and desired that they should be used at the chief observatories, together with the kite-balloon (described hereafter) for continuous observations. The Committee was enlarged by the addition of the following persons: M. Teisserenc de Bort and Prince Roland Bonaparte, of Paris; Professor Hildebrandsson, of Upsala; Professor Pernter and Lieutenant Hinterstoisser, of Vienna; Captain Moedebeck, of Strassburg, and Lieutenant von Siegsfeld, of Berlin. The next meeting will be at Paris in 1900.

During the Conference there were two trials of the kite-balloon—a captive balloon which, unlike the ordinary spherical one, is not driven down or carried away by strong winds. It is the invention of Lieutenants von Parseval and von Siegsfeld, of the German army, where it is used for reconnoitering, but the smaller Strassburg balloon, constructed by Mr. Riedinger, of Augsburg, for Professor Hergesell and Captain Moedebeck, is the first to lift self-recording meteorological instruments. It consists essentially of a cylinder of varnished linen, having a volume of 7,770 cubic feet, so attached to the cable that its upper end is inclined towards the wind, which thus tends to raise the balloon. The cylindrical form is preserved, notwithstanding leakage of gas, by admitting wind into an auxiliary envelope at the rear end, which also serves as a rudder, stability about the axis being secured by lateral wings. The instruments are contained in a basket, with open ends, hung far below the balloon. The azimuth, angular altitude and traction of the cable are recorded continuously by an ingenious dynamometer. In spite of unfavorable weather and gas of insufficient lifting power, the experiments were fairly successful, and previously the balloon had been maintained during several days above the city.

The Committee also witnessed an ascent of the *ballon-sonde* 'Langenburg,' carrying self-recording instruments. This silk balloon, when inflated with 14,000 cubic feet of coal gas, had an initial lifting force of 440 pounds in excess of its load. Owing to a premature start, the ballast was left behind, and the sudden plunge upward not only emptied some of the gas, but stopped the clock movements of the thermographs. The ascent was made in the late afternoon, and the balloon, which soon disappeared in the clouds, was found the next day about sixty miles southeast of Strassburg, having risen more than six miles, as was determined from its barometric record.

A. LAWRENCE ROTCH.

THE FIELD COLUMBIAN MUSEUM.

THE Field Columbian Museum is making fast progress and doing effective work in the various departments. The Zoological Department is busy with the rich collection brought back by Professor Elliot's expedition to Somaliland. Two notable groups have been installed in the West Court, viz.: the lesser koodoo (*Strepsiceros imberbis*) and Waller's gazelle (*Lithocranius walleri*). The first is said to be the largest and most complete of its kind in the world, and in fact the only one in existence giving a full representation of this beautiful spe-

cies. It consists of an old and a young bull, an old and a young cow and two young of different ages. The most striking accessory is an ant hill upon which is perched an African owl. The representatives of the scant plant life are faithfully executed, and, although the area is limited, the impressions of the desert are forcibly conveyed to the spectator.

The same is true of the second group, consisting of two males, two cows and two young. With its long neck, large eyes and slender body, this gazelle, the cerenuk of the natives, is graceful in form, if not in movement.

A third group, now almost ready, will represent the Oryx antelope (*Oryx beisa*) and consist of a family of five. This species will be in marked contrast to the others, on account of its rather clumsy form, that is offset, however, by its remarkably long, straight, dangerous horns, carried by both sexes. The center will be occupied by another of those ant hills which constitute so conspicuous a feature of the landscape in many parts of Africa. It is generally built around a tree, completely enclosing the trunk and nearly all the branches. After the ants have eaten the tree the hill is abandoned to be blown down by the winds. Some of them reach a height of forty feet. Together with the imposing musk-ox group, the two already finished have been attracting an ever increasing attention from visitors, who are outspoken in their admiration of the artistic skill displayed by the taxidermist, even if they fail to appreciate their scientific value.

The ultimate idea is to give most of this wing up to African collections, some sixteen groups in all having been planned, headed by a family group of polar bears, towards the center and rounded up in the rear by the musk-ox group, now in front. The final value of these and other groups as a means of creating interest in scientific research in this busy metropolis of the West can hardly be overrated.

The Anthropological Department has undergone thorough rearrangements of late, the idea being to give more prominence to the geographical distribution of the human races. Dr. Dorsey, the acting Curator, in December last, undertook a second trip to the Pueblo of Oraibi, accompanied by the sculptor Mr. F. B. Melville, for the purpose of securing plaster casts from life of Moki Indians, as well as completing the ethnological collections secured on a former trip.

The first results of this very successful expedition will soon be accessible to the public in the shape of two groups representing a Moki maiden grinding corn and a woman baking 'piki,' or paper bread. These are both to be shown in the interior of a Moki house, every surrounding detail of which will be as genuine in the reproduction as in the original. Material is on hand for another group representing a woman making pottery and a child reposing in a cradle board; for two weavers at work in their 'kivi,' or underground apartment, and for a splendid boomerang thrower. The most picturesque group, however, will probably be a Moki bride arrayed in all the splendor of her marriage finery; as also two representations of the 'katcina,' or masked dancers.

Ultimately the still more difficult task of giving some representation of the famous snake dance may be undertaken, but not until another visit to Oraibi shall have been made. On the whole, it can be confidently predicted that the Moki hall in the Field Columbian Museum, when completed, will bid fair to be unique in its kind, and will certainly prove a formidable rival in popular interest to the animal groups in the Zoological Department and the monographic representations of the forest trees of North America, fairly started in the Botanical Department.

Professor Farrington, Curator of the Geological Department, accompanied by Mr. E. S. Riggs, of Princeton University, is conducting an expedition in the Bad Lands of South Dakota for the purpose of collecting vertebrates from the White River beds. Gratifying success has attended the work of the expedition thus far. There have been secured one nearly complete small *Titanotherium* skeleton, four well preserved skulls and many miscellaneous bones of other individuals of the same genus. *Crocodile* and *Aceratherium* remains have been found in the same beds. The party will later seek to secure specimens of *Dæmonelix* from northwestern Nebraska and close the season with a visit to some newly discovered Equus beds in Montana.

President Ayer has just returned from his annual trip to Europe and Africa, and has brought back an even richer harvest for the Museum than on former occasions. Among the most interesting may be mentioned a sitting mummy of great antiquity and in a splendid state of preservation, several figure heads and busts carved in stone, and a collection of Egyptian and Etruscan jewelry. In Rome he secured two very curious incinerating tomb boxes, made from tufa in the general shape of temples, the largest being six feet long, three feet wide and two feet high, both highly decorated in archaic drawings of griffins, dogs, geese, lotus flowers and scrolls. They are thought to be of Etruscan origin and date back to from 700 to 900 B. C. The new accession will certainly prove a valuable addition to the already very respectable collections representing Italian and Egyptian archæology. n.

CURRENT NOTES ON PHYSIOGRAPHY.

YUKON GOLD DISTRICT.

A report on the Alaskan expedition of Messrs. Spurr, Goodrich and Shrader in the summer of 1896, written chiefly by Spurr, is lately published (18th Ann. Rept. U. S. G. S., 101–392). The most important physiographic contributions are in Chapter IV., by Spurr and Goodrich, in which crustal movements are inferred from the topographic forms and drainage features. Extensive pre-Neocene denudation wore down the older rocks to gentle slopes, between which the rivers meandered in broad and shallow valleys. Now elevated, this denuded region forms the 'Interior Plateau,' which, when seen from an elevated point, appears like a gently undulating plain, above which hills and mountains rise to moderate height, and beneath which the deep valleys are incised. The region about Forty-mile creek exhibits these features with remarkable distinctness; the steep-sided valley, several hundred feet deep, curves about as if incised from a meandering stream on the former valley floor; the sharp turns of the stream being known to the prospectors by the suggestive name of 'kinks.' The elevation by which the present cycle of denudation was introduced is thought to have taken the form of broad, flat folds, accelerating some streams and retarding others.

Additional information on Alaska is found in a 'Map of Alaska,' with text prepared under the direction of S. F. Emmons, published by the U. S. Geological Survey; and in Bulletin No. 16, Department of Labor, chiefly occupied with an account of a tour in Alaska by S. C. Dunham.

PHYSICAL GEOGRAPHY OF WORCESTER, MASS.

The Physical Geography of Worcester, Massachusetts, by J. H. Perry, with illustrations by J. C. Lyford (published by the Worcester Natural History Society, 1898), is one of a class of essays that are rarer than they should be in the best interests of home study. Here we find a good explanatory account of the dissected uplands of southern New England and their glacial

ornamentation with drumlins and gravel beds, such as must greatly aid the field work of any enterprising teacher who leads her classes in geography out of doors. The practical difficulty that the teacher of to-day will find in using such a guide as this essay will arise, first, from a want of a sufficiently comprehensive scheme of geographical study, by which the facts of local observation shall be correlated with geographical facts generally; and second, from the absence of a series of comparative examples, by which local features may be used to illustrate the various parts of the world which they resemble.

JAMAICA.

SPENCER continues his Antillean studies in an article on Jamaica (Late Formations and Great Changes of Land in Jamaica, Canadian Journal, V., 1898, 324–357), from which the following notes are taken: The White-limestone uplands, deeply dissected, abound in caverns and are in part uninhabitable from the numerous sinks, or 'cock-pits,' 200–300 feet in diameter and 'deeper than they are wide.' The border of the uplands is dissected by torrential wash-outs, which enter broad-floored valleys 'almost reduced to the base level of erosion.' The northern coast is comparatively abrupt in its descent into the sea; this "suggests great dislocations off that part of Jamaica, and that the forces which squeezed up the island also rammed down the sea floor to the north." On the south coast broad valleys floors independent of structure form embayments sloping to the shore line from among highland spurs. The lower portions of certain streams have cut canyons beneath former broad valleys floors, indicating recent uplift; several examples of this kind being shown on the northern coast.

CUBA.

A 'TIMELY' article on Cuba from the competent pen of R. T. Hill is the leading article in the 'Cuba number' of the National Geographic Magazine (IX., 1898, 193–242). Besides a brief summary of physiographic features, it gives a good general account of population and industries, in which the physiographic control is well brought forward. A contour map, compiled from the best known authorities, is a valuable contribution to the geography of the island.

APPALACHIA.

THE latest number of Appalachia, March, 1898, includes a number of good illustrations of the Canadian Rocky Mountains from photographs, some of which are from the great series taken by the Dominion Topographical Survey. The usual mountain-climber's narratives are by Thompson and Habel. The region is of strong Alpine scenery—grand snow fields aloft; great glaciers descending into the upper valleys; old moraines of huge size farther down; avalanche paths on steep slopes beneath high cliffs; lakes curiously related to the larger valleys. Although as yet not productive of many physiographic essays, there is no part of his continent that offers so good and so accessible a field for the careful study of Alpine forms.

W. M. DAVIS.

CURRENT NOTES ON ANTHROPOLOGY.

THE RATIO OF HUMAN PROGRESS.

AT the last meeting of the British Association, Mr. George Iles read a suggestive paper, 'Why human progress is by leaps.' He points out that the triumphs of man over nature in the discovery of its laws of action are not simple additions to his resources, but are multipliers of high potency, often extending over the whole field of his activity. This he illustrates by the manifold applications of electricity in our own day, and by the use of fire in prehistoric times. He draws the conclusion that man's

advance will in the future be at a continually accelerated pace.

This reasoning is closely akin to that of Lewis H. Morgan in the chapter on the rate of human progress in his 'Ancient Society' (New York, 1878). He there argues that culture-progress proceeds by geometrical, not arithmetical ratios; which is substantially Mr. Iles' position.

It should be borne in mind, however, that true culture cannot be measured by criteria drawn solely from the utilitarian arts. Civilization has been nicely defined by a French writer as a 'state of mind,' rather than a schedule of possessions; and this is signally true.

THE ITALIAN ANTHROPOLOGICAL INSTITUTE.

Under the title 'Istituto Antropologico Italiano,' Dr. Giuseppe Marina has opened at Leghorn an establishment which has for its aim the popularizing of anthropologic work, and also the collection of material for scientific purposes. It embraces psychological, antropometrical, pathological and ethnographic investigations. Persons can apply and for a moderate fee have themselves examined by the most approved modern methods in all these directions. A careful record is kept, and the same individual may return from time to time to have the examination repeated—a procedure in which he has a personal interest, while the comparative results thus obtained will prove of value to science. In addition to this feature, lectures, publications, open discussions and other plans for attracting and educating the public in anthropologic matters will be cultivated. The history of culture, demography, sociology and hygiene will be brought forward with especial prominence.

Dr. Marina deserves great credit for this excellent and original scheme of bringing home to the general public the practical value of anthropology. A descriptive circular may be obtained by addressing him (Livorno, Italy).

'ORGANIC' SOCIOLOGY.

There was a time when it was quite useful to speak of language as an 'organism' and human society as an 'organism.' The word brought the inter-relation of parts clearly to the mind. That there was any actual identity, either of parts or of functions, or of laws of growth, with anatomical organisms was not intended. Of late, however, a class of writers have insisted on such identity, and have carried it out in quite ridiculous parallels, such as that the railroads are arteries, the frontiers are the epidermis, etc. (Lilienfeld, Worms).

Nothing is gained by these similes, which are, in fact, empty literary formulas; and it is gratifying to see that such solid writers as Lester F. Ward, in this country, in the *Journal of Sociology*, and Dr. S. R. Steinmetz, in the *Zeitschrift für Socialwissenschaft*, have condemned them as unscientific, and barren of profitable results. As much may be said of the term 'super-organism,' proposed by Mr. Herbert Spencer, though that writer defines it in such a manner as to divest it of most of its erroneous suggestiveness. Professor Giddings adopts 'physio-psychic organism' as the correct term for the social group; but this is just as applicable to the living individual, and, applied to a society, may be as misleading.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

Fuller particulars regarding the liquefaction of hydrogen and helium by Professor Dewar have come to hand in his paper in the *Proceedings* of the Chemical Society. As early as 1895 Dewar had constructed an apparatus by which he could produce a jet of hydrogen containing liquid. It was then shown that such a jet could be used to cool substances below the temperature which

could be reached by the use of liquid air. A much larger apparatus of the same type was then constructed, in which the liquid air plant was combined in its circuits and arrangements for the liquefaction of hydrogen. The construction of this apparatus consumed a year, and many months were occupied in preliminary trials and tests. On May 10th hydrogen was liquefied by allowing the gas, cooled to −205°, and under a pressure of 180 atmospheres, to escape continuously, at the rate of ten to fifteen cubic feet per minute, from the nozzle of a coil of pipe in a double silvered vacuum vessel of special construction, surrounded by a space kept below −200°. Liquid hydrogen commenced to drop from this vacuum vessel into another doubly isolated by being surrounded by a third. 20 cc. liquid hydrogen were obtained before the hydrogen jet froze up from the solidification of the air in the pipes. Liquid hydrogen is clear and colorless, showing no absorption spectrum, and the meniscus is as well defined as in the case of liquid air. It has a relatively high refractive index and dispersion, and its density appears to be in excess of the theoretical value 0.18 to 0.12, deduced from its atomic volume in organic compounds, and the limiting density found by Amagat for hydrogen gas under infinite compression. Dewar's experiments have given a density of 0.62 for hydrogen condensed by palladium, and this may not be far from the value for the liquid. No arrangements were at hand to determine the boiling point of hydrogen, but it must be excessively low, for a long piece of glass tubing sealed at the lower end and cooled by immersion in liquid hydrogen immediately filled with solid air where it was cooled. A tube of helium from the Bath gas was placed in liquid hydrogen, and a distinct liquid was seen to condense, thus showing that there cannot be any great difference in the boiling points of hydrogen and helium. All known gases have now been condensed to liquids which can be manipulated at their boiling points under atmospheric pressure in suitably arranged vacuum vessels. With hydrogen as a cooling agent, it will be possible to get within 20° or 30° degrees of the absolute zero, and its use will open up an entirely new field of scientific inquiry.

IN seconding a vote of thanks to Professor Dewar, moved by Sir William Crookes, Dr. Armstrong called attention to the fact that in the earlier days of the Chemical Society much attention had been given to the discussion of the properties of hydrogen, and the view that it possessed metallic properties had been strongly advocated. This was strongly supported by Graham's investigations of hydrogenized palladium, or, hydrogenium, as Graham called it, condensed on palladium. Dr. Armstrong ventured to think, however, that the subject had been too much regarded from the inorganic side, and that when the evidence to be derived from organic chemistry is taken into account it is more probable that hydrogen will be found to resemble the petroleum hydrocarbons rather than the metals. In reply to a query from Dr. Armstrong, Professor Dewar said that, since argon solidifies when cooled in liquid air, his experiment with helium shows that the gas (helium) from the Bath well does not contain argon, and, unless possibly hydrogen is present in small quantity, the helium from the well was pure.

ACCORDING to chemical literature the dark precipitate obtained by reducing bismuth solution with alkaline stannous chlorid is the monoxid, BiO. This oxid is also supposedly obtained in the fusion of the metal. L. Vanino and F. Treubert, of Munich, publish in the *Berichte* an investigation of this compound, and show that in the former case the precipitate is metallic bismuth and in the latter the compound is a mixture of the metal with the ordinary oxid

Bi_2O_3. This study shows the importance of repeating much of the work of earlier chemists. With the superior methods of manipulation and increased knowledge of to-day, much of the superstructure of the theory of inorganic chemistry rests upon a very insecure foundation of facts. In view of the decreasing affinity in the elements of the fifth group with increase of atomic weight, the existence of the oxid BiO is theoretically very probable, but that it really exists has not been shown experimentally. The same authors show that in an alkaline lead solution stannous chlorid precipitates all the lead as metallic lead.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE ROYAL GEOGRAPHICAL SOCIETY.

THE annual meeting of the Royal Geographical Society was held in London on May 23d, Sir Clements Markham in the chair, and the annual dinner of the Society took place in the evening. At the annual meeting the medals of the Society were presented to Lieutenant Peary, Dr. Sven Hedin and others in accordance with the award that we have already announced. The President then delivered his annual address, in the course of which he said, according to the report in the London *Times*, that a very sympathetic reply had been received from the Prime Minister's private secretary to the appeal on behalf of a government Antarctic expedition. A meeting of very great interest was held in the beginning of the year by the Royal Society, in which eminent authorities were unanimous in insisting on the necessity of renewing Antarctic exploration, and on the duty of the British government to take a substantial share in it. A German expedition was being organized on a liberal scale, and funds were being collected throughout Germany for the purpose. Moreover there was reason to hope that the Norwegian government might send out an expedition also, perhaps under the leadership of Dr. Nansen, to carry out exploration mainly on land. Meanwhile the Belgian expedition, under M. de Gerlache, had been actively engaged, and the expedition, liberally supported by Sir George Newnes, under M. Borchgrevink, was in an advanced state of preparation. After a brief reference to Mr. Jackson's account of the Jackson-Harmsworth expedition, to Lieutenant Peary's labors and to those of Captain Sverdrup, Colonel Fielden, Mr. Pearson, Mr. Arnold Pike and Sir Martin Conway, the President said that German and Swedish expeditions were in progress for Spitzbergen and Franz Josef Land. Germany was setting an admirable example in scientific exploration. Besides the Antarctic expedition referred to, the German government had made a grant of £15,000 for oceanic research, especially in the Atlantic and Indian oceans. In the North Atlantic much good work was done under the joint cooperation of the Swedish, Norwegian, German and British governments. He hoped that during the coming summer authentic and satisfactory information concerning the hazardous balloon expedition undertaken by M. Andrée might be received. After reference to the other papers and the results of other expeditions during the past year and to the most important publications of the year, the President briefly dealt with the subject of education.

He said that both at Oxford and Cambridge geography continued to improve its position. At Oxford the University bore the entire expense of the readership. After long and careful consideration, the Council decided to continue the Society's contribution to the Cambridge lectureship, on the understanding that the University would take it over at the end of five years, and that the lectureship would be elevated to a readership. The reader, Mr. Yule Oldham, sent a satisfactory report of the work during the past year. With regard to Oxford, Mr. Mackinder had given the Society an account of his labors both at Oxford and at Gresham College. The measures adopted by the Council last year for increasing the efficiency and extending the scope of the system of instruction conducted by Mr. Coles had quite fulfilled expectations. Last year (1896–97) 41 intending travellers received instruction from Mr. Coles, one of whom was granted the Society's diploma. In the present year (1897–98) 65 intending travellers had received instruction, an

increase of 24, and five of these had passed before the Committee and received diplomas, one of them being a lieutenant in the navy. Among the pupils there were 26 civilians, 24 officers of the army and navy, four in the colonial service, four civil engineers and two missionaries. The Society owes much to Mr. Coles for the pains and trouble he had taken, and for the time he had devoted to the work of teaching. This year the Society had reached and passed the four thousandth figure in the number of its Fellows. This was a landmark in their progress, while the most notable events in their history this year were the grant of diplomas and the creation of a growing number of trained scientific explorers.

LIQUID HYDROGEN.

AT the meeting of the London Chemical Society on June 2d Professor Dewar gave a short account of the first attempts made to determine the physical constants of liquid hydrogen. Among the most interesting points brought forward, according to the report in the London *Times*, was that just as in the middle of the last century chemists were startled by Cavendish's discovery of a factitious gas, namely, hydrogen, having a density one-fourteenth that of air, so now they were startled by finding in liquid hydrogen a liquid having a density of 0.07, or roughly one-fourteenth that of water. Hydrogen occluded in palladium has been found to have a density of 0.62. Whatever, therefore, be the form in which it exists in that metal it is more than eight times denser than in the liquid condition, and consequently must be in a state of chemical combination, and not merely in one of liquefaction. Liquid hydrogen is thus by far the most extraordinary liquid known. The lightest liquid hitherto obtained is liquid marsh-gas, which has at its boiling-point a density of about two-fifths that of water. Liquid hydrogen, therefore, has only one-sixth of the density of liquid marsh-gas, and the surprising thing is that having such a small density it is so well defined, so easily seen, and so capable of collection and manipulation in vacuum vessels.

Professor Dewar has determined the boiling-point of the liquid by means of a platinum resistance thermometer—practically the only form available at such low temperatures. The result he has obtained is —238° C. at atmospheric pressure; in other words, liquid hydrogen boils steadily at 35° above the zero of absolute temperature. From all analogy it is inferred that the lowering of temperature that will be produced by forcing the liquid to boil *in vacuo* cannot amount to more than 10 or 15°. It is, therefore, possible to say with confidence that at the present moment science can project no method that will get nearer to the absolute zero than 20 or 25°.

The boiling-point of liquid hydrogen is really higher than suggested by theory and the work of other experimenters. The density of the vapor coming off from the boiling liquid is eight times denser than the gas at ordinary temperatures, whereas in the case of liquid air the vapor is only four times heavier. Liquid hydrogen again is 100 times denser than the vapor it is giving off, whereas the density of liquid oxygen is 255 times greater than that of its vapor. The atomic volume of liquid hydrogen at its boiling point is 14.3, while that of oxygen is 13.7.

It may be mentioned that the platinum resistance thermometer when immersed in the liquid hydrogen is cooled to within six platinum degrees of its zero point, so that if cooled these few degrees more—as it can be by means of the liquid boiling under reduced pressure—it must break down, becoming an infinite conductor with no resistance.

GENERAL.

BOSTON UNIVERSITY has conferred the degree of LL.D. on Alpheus Hyatt, professor of zoology and paleontology in the University.

PROFESSOR W. M. DAVIS and Professor E. L. Mark will take advantage of the sabbatical year allowed by Harvard University to spend the period in study and research abroad, while Professor W. G. Farlow will spend the winter in the West Indies. Professor H. F. Osborn, of Columbia University, is also enjoying a sabbatical year and is at present abroad.

THE Loubat prizes of Columbia University, awarded every fifth year, alternately for works on the history, geography and numismatics of

North America, and on the archæology, ethnology and philology of North America, were this year given in the latter group. The first prize of $1,000 was awarded to Mr. W. H. Holmes, of the United States National Museum, and the second prize of $400 to Dr. Franz Boas, of the American Museum of Natural History and of Columbia University. We hope to publish later the detailed report of the committee, which consisted of Professor H. T. Peck, Professor D. G. Brinton and Dr. W J McGee.

PROFESSOR JACOB REIGHARD, of the University of Michigan, will, during the present summer, make, under the auspices of the United States Fish Commission, a biological examination of Lake Erie. His party will include Professor H. B. Ward, of the University of Nebraska; Mr. A. J. Pieters, and others. During the month of July the party will be engaged in a laboratory established in the United States Fish Hatchery at Put-in-Bay Island, O. In August the work will be continued in a steamer chartered for that purpose.

PROFESSOR KREUTZ telegraphs that Encke's periodical comet has been observed at Mr. John Tebbutt's Observatory, Windsor, N. S. W. Professor Keeler announces the discovery, photographically, on June 11th, of a bright comet, by Mr. E. F. Coddington, of the Lick Observatory.

PROFESSOR RAMSAY has discovered another gaseous element in the air and called it krypton. It was first announced by M. Berthelot at a meeting of the Paris Academy of Sciences on June 6th, and was exhibited at the *conversazione* of the Royal Society on the 8th. The new gas is closely related to helium, and exists in common air in the proportion of about one to twenty thousand. We hope to give further details when the scientific publication of the discovery has been made.

PROFESSOR NERNST, of the University of Göttingen, has recently devised a new form of electric lamp that promises to be of the very highest importance. It differs from the ordinary lamp in that it has a filament composed of magnesia mixed with rare earths, instead of the ordinary filament in a vacuum. The vacuum is not necessary in the new lamp. The filament of Nernst's lamp is non-conducting when cold, but on being warmed it conducts, and then glows with a very brilliant light. The advantages are that it suffers no decomposition in the air and requires very much less current (about one-third) than the old electric lamp. The problem at present seems to be to find a convenient method for warming the filament, as that cannot be done directly by the current.

MAJOR GIBBON left England on May 26th, with seven other members of his party, for South Africa, with a view of traversing the continent from the Cape to Cairo. He expects to make a journey of about 12,000 miles in eighteen months. The party has the support of the Royal Geographical Society and of the government.

NEWS has been received from M. de Behagle, the African explorer, in which he was on March 2d about to ascend to Mobai to meet M. Liotard, Governor of Upper Ubangi, who had accompanied the Marchand mission and was descending to Brazzaville. On his return to Wadda he intended to go north in the direction of Lake Chad.

PROFESSOR WARREN K. MOOREHEAD, of Columbus, O., has returned from a trip to southern Arizona, where he has made valuable archæological discoveries in the Slado Valley.

A MEETING of the general committee to make arrangements for the Bristol meeting of the British Association was held on June 6th. It was reported that the sum of nearly $20,000 had been collected locally for the reception of visitors. It is expected that there will be about 2,000 members present.

THE second of the *conversaziones* of the Royal Society, to which, as usual, ladies were invited, was held on June 8th. The most remarkable exhibit was Professor Ramsay's new gas krypton, the spectrum of which was shown along side of those of sodium and helium. Though part of the exhibits were similar to those shown at the soirée a month or so ago, there were several new exhibits of interest.

THE British Institution of Civil Engineers held its annual *conversazione* at its rooms in London on May 26th. There were many ex-

hibits of scientific and technical interest, and various demonstrations were given during the evening.

THE annual Congress of the Institute of Public Health of Great Britain will be opened at Dublin on August 18th, under the presidency of Sir Charles Cameron. A health exhibition will be held in connection with the Congress, which will include, in addition to sanitary appliances, bicycles and tricycles and motor cars.

THE sixty-sixth annual meeting of the British Medical Association will be held at Edinburgh, on Tuesday, Wednesday, Thursday and Friday, July 26, 27, 28, 29, 1898. The President is T. G. Roddick, M.D., professor of surgery in McGill University, Montreal, and the President-elect, Sir Thomas Grainger Stewart, M.D., LL.D., F.R.S.E., professor of practice of medicine and clinical medicine in the University of Edinburgh. The address in medicine will be delivered by Thomas Richard Fraser, F.R.S., professor of materia medica and clinical medicine in the University of Edinburgh; the address in surgery by Thomas Annandale, Regius professor of clinical surgery, University of Edinburgh, and the address in psychological medicine by Sir John Batty Tuke, lecturer on insanity, School of Medicine of the Royal Colleges, Edinburgh. The scientific business of the meeting will be conducted in sixteen sections.

THE triennial meeting of the German meteorological Society was held this year during the week after Easter at Frankfort-on-the-Main. In the absence of the President, Professor Dr. Neumayer, Director of the Deutsche Seewarte, presided. He reviewed the progress of meteorology during the past twenty-five years and concluded that Antarctic exploration affords a profitable field for meteorological and magnetic investigations. Among the dozen papers presented one of the most interesting was a study of the amount of sunshine in North America as compared with that in Europe, by Professor Dr. van Bebber. Two honorary members were chosen: Dr. Rykatcheff, Director of the Central Physical Observatory at St. Petersburg, and Professor Dr. Neumayer, who now retires from the direction of the Society, which he assisted to form in 1883. Eight corresponding members were elected: Messrs. Paulsen, of Copenhagen; Snellen, of Utrecht; von Konkoly, of Buda-Pest; Hepites, of Bucharest; Pernter, of Vienna; Lancaster, of Brussels; Sapper, of Guatemala, and Rotch, of Boston, U. S. A.

AT the coming convocation of the University of the State of New York the leading chiefs and sachems of the Iroquois, representing the Five Nations, will be present on Wednesday, June 29th, at a formal commemoration and ratification of the election of the University as the permanent wampum keeper of the Iroquois League, and of the deposits in the fire-proof State Capitol of these most precious relics of the famous Five Nations. Brief speeches will be made by representatives of the different tribes, and some of those most familiar with the history and traditions of the Indians say that the event will be, probably, the last general gathering of the Five Nations, and will, therefore, be specially significant.

LORD LISTER, President of the Royal Society, has consented to perform the opening ceremony of the new laboratories of physiology and pathology erected and equipped at University College, Liverpool, by the Rev. S. A. Thompson-Yates, at a cost exceeding £25,000. The opening is fixed for October 8th, when Victoria University will confer on Lord Lister the honorary degree of Doctor of Science.

FREDERICK C. SAYLES, first Mayor of Pawtucket, R. I., has offered to present the city with a free public library in memory of his wife, Deborah Cook Sayles, and has purchased for $22,500 a site for the same on Summer street.

WOMEN physicians will hereafter be eligible to all official positions in Russia. They will receive the same salaries and pensions as men.

THE Audubon Society of Illinois has secured the conviction of a dealer in Chicago who had in his possession native song birds. It was claimed that the birds were taken in Mexico and elsewhere, but the conviction was obtained in spite of the fact that the place of capture could not be proved.

RECENT issues of the London *Times* announce the deaths of three English men of science, and

give obituary notices, from which we copy. Mr. Osbert Salvin, the eminent ornithologist, died on June 1st at his residence, Hawksfold, near Haslemere. The son of the late Mr. Anthony Salvin, the well-known architect, he was born in 1835, and received his education at Westminster and Trinity Hall, Cambridge, where he graduated as a Senior Optime in the Mathematical Tripos of 1857. Immediately after taking his degree he, together with Mr. W. H. Hudleston (then Simpson), joined Mr. (now Canon) Tristram in his natural history exploration of Tunis and eastern Algeria, where they passed five months. In the autumn of the same year Mr. Salvin proceeded to Guatemala, where, chiefly in company with the late Mr. G. U. Skinner, the celebrated collector of orchids, he stayed till the middle of 1858, returning to Central America (henceforth always to be associated with his name) about twelve months later. He again went out in 1861, accompanied by Mr. Frederick Godman, and continued the explorations he had already begun, but was home again in 1863. In 1865 he married Caroline, the daughter of Mr. W. W. Maitland, of Loughton, in Essex, and with her subsequently undertook another voyage to Central America. In 1874, on the foundation of the Strickland Curatorship in the University of Cambridge, he accepted that office, which he filled until 1883, when, on his father's death, he succeeded to the property at Hawksfold, and moved thither, though there was hardly a week in which he did not pass some days in London, for, with Mr. Godman, he had conceived the idea of bringing out a 'Biologia Centrali-Americana,' being a complete natural history of the countries lying between Mexico and the Isthmus of Panama. This gigantic task, by far the greatest work of the kind ever attempted, taxed all their united efforts, and those of the many contributors they enlisted, and is still in progress. Before beginning this, Mr. Salvin had edited the third series of 'The Ibis,' of which he was one of the founders, and had brought out a 'Catalogue of the Strickland Collection' in the Cambridge Museum. He contributed also the *Trochilidæ* (humming birds) and *Procellarildæ* (petrels)—on which last group he was the acknowledged authority, to the British Museum 'Catalogue of Birds,' and almost his latest labor was that of completing and arranging the late Lord Lilford's 'Coloured Figures of British Birds,' while the Royal Society's 'Catalogue of Scientific Papers' enumerates 47 published by Mr. Salvin alone, 23 by him and Mr. Godman jointly, and 54 by him and Mr. Sclater, all before 1884. Mr. Salvin was a Fellow of the Royal, the Linnæan, the Zoological and the Entomological Societies, on the Councils of all of which he frequently served.

The death occurred on June 6th at Cambridge, in his 81st year, of the Rev. Percival Frost, F.R.S., D.Sc. Born at Hull, while his father practiced as a solicitor, he was educated at Beverley, Oakham and Cambridge, where he was second wrangler and first Smith's prizeman in 1839, Fellow of St. John's College from that year to 1841, mathematical lecturer at Jesus College from 1847 to 1859, mathematical lecturer at King's College, Cambridge, from 1859 to 1889. He had been a Fellow of King's College since 1882, in which year he was also elected a Fellow of the Royal Society. Dr. Frost was the author of treatises on 'Curve Tracing,' 'Solid Geometry,' 'The First Three Sections of Newton's Principles,' as also of numerous papers published in the *Cambridge Mathematical Journal*, the *Oxford and Cambridge Journal of Mathematics*, and the *Quarterly Journal of Mathematics*.

Mr. Henry Perigal, the Treasurer of the Royal Meteorological Society, died on June 7th at the advanced age of 97 years. Mr. Perigal was for some time a clerk in the Privy Council Office, and afterwards in the old Victualling Office. Subsequently he joined the firm of Messrs. Henry Tudor & Son, of Threadneedle street. He was the author of various works on astronomy, bicycloidal and other curves, kinematics and the laws of motion, probable mode of constructing the pyramids, etc. He was a Fellow of the Royal Astronomical, Royal Microscopical and Royal Meteorological Societies, as well as a member of several other scientific associations, and until within two years of his death was constant in his attendance at their meetings.

THE University of Pennsylvania Press has published a 'Syllabus of Lectures on the Vertebrata,' by the late Professor E. D. Cope. It is stated in the preface that the book is a corrected and extended edition of 'The Syllabus of Lectures on Geology and Paleontology,' Part III.: 'Paleontology of the Vertebra,' published in 1891, and was originally designed for use in the extension lectures of the University. The book includes an introduction of thirty-five pages on the 'Life and Works of Cope,' by Professor Osborn, and a portrait of Cope as frontispiece. A limited number of copies of this work is offered for sale, in cloth for $1.25, or with a paper cover for $1.00.

THE first of the four volumes of Huxley's Scientific Memoirs has been issued. The work, which Professor Michael Foster and Professor Ray Lankester are editing, is being published by The Macmillan Company as a contribution to the Huxley memorial. A portrait of Huxley, taken in 1857, serves as a frontispiece of the volume, which contains 600 pages.

MESSRS. G. P. PUTNAM'S SONS have just issued, as the first volume of their 'Science Series,' 'The Study of Man,' by Professor A. C. Haddon. They have arranged for the following volumes of the series in addition to those already announced: 'Rivers of North America,' by Professor Israel C. Russell; 'Whales,' by F. E. Beddard; 'Bacteria,' by Dr. J. H. Gladstone; 'History of Botany,' by Professor A. H. Green; 'Planetary Motion,' by Dr. G. W. Hill, and 'Infection and Immunity,' by Dr. George M. Sternberg. The title of Professor Young's book has been changed to 'Meteors and Comets,' and that of Professor Brinton's to 'Ethnic Psychology.'

M. MOURLON, of the Belgian Geological Survey, writes that the favorable reception met with by Volume I. of the series B of the *Bibliographia geologica*, cataloguing the publications since the 1st of January, 1896, and Volume II., soon to be ready, leads the Survey to publish Volume I. of the series A, or retrospective series, giving the titles of geological publications published prior to 1896. The first volume of this series will comprise the titles of all geological publications of the library of the Geological Survey, and will consequently constitute the first part of the catalogue of this library (drawn up according to the decimal classification). Authors are requested to send copies of their publications in order that they may be included in the Bibliography.

UNIVERSITY AND EDUCATIONAL NEWS.

THE late A. S. Van Wickle, of Hazleton, Pa., has bequeathed $45,000 each to Princeton University and to Brown University and $30,000 to Lafayette College.

CHANCELLOR MACCRACKEN, of New York University, has announced an anonymous donation, thought to be from Miss Helen Gould, of $50,000 to New York University.

MT. HOLYOKE COLLEGE receives $5,000 by the will of the late Elijah A. Morse, and Tufts College $2,000 by the will of the late Mrs. Eugenia Stowe, of Meriden, Conn.

THE Board of Trustees of the University of Rochester has adopted resolutions admitting women to the institution when $100,000 shall have been raised for the purpose.

AT the recent commencement exercises of the University of Nebraska 88 students were admitted to the degree of Bachelor of Arts, 44 to the degree of Bachelor of Science, 39 to the degree of Bachelor of Laws, 40 to the degree of Master of Arts, and 2 to the degree of Doctor of Philosophy. The University long since abandoned the practice of conferring advanced degrees upon any other basis than that of resident work under the direction of the faculty.

IT is reported that President Andrews, of Brown University, has been offered and will accept the superintendency of the public schools of Chicago.

THE following promotions have been made at Johns Hopkins University: Dr. Joseph S. Ames to a full professorship of physics; Dr. J. Elliott Gilpin and Dr. Harry C. Jones to be associates in chemistry and physical chemistry, respectively, and Dr. Luis E. Livingood to be associate in pathology. The Bruce fellowship was awarded to Gilbert A. Drew, of Iowa, who this year receives the degree of Ph.D. in biology.

AT a recent meeting of the Regents of the University of Nebraska, Dr. Frederic E. Clements was promoted from the position of assistant to that of instructor in botany. The following were elected fellows for the collegiate year 1898–9: In mathematics, C. C. Engberg and Alta Johnson; in chemistry, Mariel C. Gere, Benton Dales and Howard C. Parmelee; in pedagogy, William R. Hart; in zoology, Albert B. Lewis and Charles C. Morison; in geology, Cassius A. Fisher; in physics, Samuel R. Cook; in electrical engineering, Charles H. True, and in botany, Albert T. Bell and Cora F. Smith.

MISS AGNES MARY CLAYPOLE, instructor in Wellesley College, has been appointed assistant in the department of histology and comparative physiology in Cornell University.

DR. SOPHUS LIE, professor of mathematics in the University of Leipzig, has *angenommen* accepted a call to the University of Christiania.

DR. GISEVINUS has been appointed associate professor of agriculture in the University of Königsberg; and Dr. Richard Wachsmuth, of Göttingen, has been called to a professorship of physics in the University of Rostock.

DISCUSSION AND CORRESPONDENCE.

'A PRECISE CRITERION OF SPECIES.'

THE papers by Professor C. B. Davenport and J. W. Blankinship, suggesting the determination of species by means of statistical methods, are welcome signs that the appreciation of the value of these methods is rapidly increasing among biologists. Heretofore they have been applied most extensively by anthropologists; consequently the inherent difficulties have become familiar to them, and their experiences will be useful to biologists who pursue these methods.

Statistical data are generally represented in the form of curves; and experience show that most curves, if the number of cases is sufficiently large, approximately conform to the probability curve. When the number of cases is small the curves tend to become more and more irregular, and the question arises: How large must the number of cases be in order to be significant, that is to say, in order to justify us in assuming that the few selected individuals represent a curve which deviates from the probability curve? All the curves given by Professor Davenport and Professor Blankinship in their paper are based on material not sufficiently extensive to compel us to assume that the distribution differs from the law of probability. For example, the data contained in Fig. 9, which is one of the best of Professor Davenport's examples, are not of such a character that we must necessarily assume a curve deviating from the normal probability curve. If a thousand individuals had been measured instead of forty-six only, irregularities of the curve would probably disappear. The same is true of Professor Blankinship's measurements. The secondary maximum in his best table (No. VI., Fig. 17) is so uncertain that, until further data are forthcoming, we must assume that with an increased number of measurements the secondary maximum will disappear entirely.

Furthermore, it must be considered that under certain conditions the distribution of measurements cannot conform to the probability curve. Such is the case in conditions like those exemplified in Table VII. of Professor Blankinship's paper. Here the greatest relative frequency is that of the value zero. Smaller values are not possible; consequently all the variations must be on the positive side. The same is true wherever the measured value is very near zero. In these cases the distribution must be a symmetrical.

But granted the supposition that curves exist which have more than one maximum, the question arises whether we are justified in assuming that the two maxima represent two species inhabiting the same area. First of all, it must be mentioned that, assuming equal frequency and equal variability of the two species, two maxima will occur only when the distance between the two types is greater than the standard deviation of either type. When the difference is less, the result is apparently an increased variability. When two maxima exist, the biological problem resolves itself into a mathematical analysis of the given curve. Owing to the impossibility of obtaining sufficiently extensive material, and to the consequent inaccuracies of the results of

observations, as well as on account of the complexity of the curve, such an analysis must always be based on certain biological assumptions. Karl Pearson has shown how difficult an analysis of such curves is. If we assume that the composite curve results from measurements of two coexisting species we make one of many possible assumptions. Natural selection and mixture are two causes which may have effects of a similar character. When, for instance, two distinct types interbreed, and the offspring show a tendency to revert to either parental type, curves will result with two maxima, each representing one of the parental types; but this curve does not originate by addition of the two composing curves; it is much rather an unknown function of these curves. A case of this character was described by me when treating of the anthropometric characteristics of the descendants of Indian mothers and white fathers. On the other hand, when natural selection acts in such a way that a certain group of individuals is least favored, and if these individuals are not far removed from the average type, curves with two maxima may develop. It will, therefore, be seen that the mere existence of curves with two maxima does not by any means signify the existence of two distinct species.

The question of correlation, which has been well set forth by Professor Blankinship, seems a most interesting one, and has received very able treatment at the hands of Karl Pearson, who clearly set forth the theory of this subject. It does not seem likely that this method can be utilized for distinguishing between specific and individual characters. In the same species certain organs prove to be strongly correlated, while others are only slightly correlated; and according to this degree of correlation the proportions will change among various types, and it is probable that the degree of correlation will remain the same among all closely related types.

Since the application of statistical methods to zoology is still in its infancy, it is to be hoped that the study may be taken up according to strict methods, in order to avoid erroneous conclusions.

FRANZ BOAS.

SCIENTIFIC LITERATURE.

J. BOLYAI, *Scientia Spatii Absolute Vera.* With a Magyar translation by SUTÁK J., and a biography by FR. SCHMIDT. Budapest, Schmidt Ferencz. 1897. 8vo. Pp. xxviii + 143.

W. BOLYAI DE BOLYA, *Tentamen juventutem studiosam in elementa matheseos puræ elementaris ac sublimioris methods intuitiva evidentiaque huic propria introducendi, cum appendice triplici.* Budapestini, Sumptibus Academiæ Scientiarum Hungaricæ. 1897. Editio Secunda. Tomus I. 4to. Pp. xii + 679. Price, 50 francs.

Sixty-five years after its issue from the little provincial press of the 'Collegii Reformatorum' in Maros Vásárhely, why does the proud Hungarian Academy of Science reissue, in sumptuous quarto form, a magnificent *édition de luxe*, this strange Tentamen?

Bolyai Farkas (Wolfgang Bolyai) has two unimpeachable certificates of immortality. He was the father of Bolyai János, and he first publicly appreciated Lobachévski. The second of these two titles, though destined to bulk large in the final history of human thought, has never before been explicitly mentioned by any one, so far as I know. I here call attention to it for the first time. If any praise or appreciation of Lobachévski was ever published or printed before 1851, I have never heard of it. In Russia he found only such rude and offensive ironies as fill a criticism in one of the St. Petersburg journals, 'Son of the Fatherland,' 1834, or else complete indifference. The academician V. Bunyakovski in his work, 'Parallel Lines,' printed in 1853, does not even mention the investigations of Lobachévski. Among his own pupils not one worked at his ideas or appeared as their convinced defender.

Vasiliev, Engel and Staeckel give 1866 as the date of the beginning of the movement to recognize the non-Euclidean geometry. Vasiliev attributes the start to the Frenchman Hoüel, 'whom we must remember to-day with gratitude.' Engel in a note to this sentence of Vasiliev's Address traces back the initiative to Baltzer: "Hier haette Baltzer erwaehnt werden sollen, durch den Hoüel erst auf Lobatschefskij und Bolyai aufmerksam gemacht worden war." This was stated by Hoüel himself

in 1867: "C'est aux indications du Dr. Baltzer que je dois la connaissance de ces importants travaux."

Thus interested, Hoüel besought aid of an architect of Temesvár who had written to enquire of him about French mathematical books. The coincidence was most fortunate, for this architect was Fr. Schmidt, whose father, Anton Schmidt, had often told him of a young officer of engineers with whom he always feared to come in contact, who, to prove the might of his arm and the temper of his Damascus blade, was accustomed to show his visitors how with one stroke he could cut off a heavy nail driven into his door-post. This was Bolyai János. The facts collected by Fr. Schmidt in 1867, published in Grunert's Archiv and by Hoüel in 1868, were all the world knew of the two Bolyai for nearly thirty years.

Moreover, the first biographer became a sort of local representative for the world of science in all matters pertaining to Bolyai János. He procured for Hoüel two copies of the exceedingly rare 'Science Absolute,' from one of which Hoüel made his French translation, sending the other to Battaglini, who translated it into Italian, both translations appearing in 1868. In 1872 Schmidt furnished Frischauf the original for his German version. Now in 1897 he publishes at his own expense the Latin, with the first rendering in the native tongue of the author, the Magyar, and a new biography of János, but far too short, nine pages.

The Hungarian Academy of Science, in their costly edition of the father's Tentamen, have so rearranged the material that the immortal Appendix of the son is displaced from the first volume, the only one yet issued. Both the above books are, therefore, needed by one who would contrast the concise elegance of the son, who solved the problem of the ages, with the florid freedom of the father, who had failed.

The 'Science Absolute' has appeared in six languages and a Japanese reprint of the English.

The Tentamen will probably never be translated. Suták points out how it anticipates Riemann and Helmholtz.

(1) Space is continuous (V. I., p. 442).

(2) Rigid bodies exist independent of place, freely movable (principle of congruence, p. 444).

(3) Rigid bodies can move with one or two points fixed, not in general three (p. 446).

(4) Monodromie (p. 447) (motion which continued brings a point again into its first place).

From Lie's reinvestigation results that this fourth principle is a consequence of the others, though here Suták has the hardihood to attack Lie.

This anticipation is carried out consequently, and would have been complete, except that W. Bolyai postulates the infinity of space.

Now follows the first appreciation ever printed of the non-Euclidean geometry. W. Bolyai has the double honor, first to have praised in print each of the two founders of this marvellous doctrine. He was the first convert who dared profess his regeneration openly. The world waited thirty-five years for a second.

One sentence from the Tentamen must serve as specimen of his praise and penetration: "The Author of the Appendix, attacking the matter with singular acumen, comprehending in general (if except the remaining axioms none be assumed) all systems subjectively possible for us (that is, of which one only exists, though which is really true we cannot decide) makes a geometry absolutely true for every case; though in the Appendix of this volume he has given from a great mass only the strictly necessary, much (as the general solution of the tetrahedron, and many other elegant disquisitions) for the sake of brevity being omitted." His praise and discriminating exposition of Lobachévski was printed twenty years later.

In his 'Kurzer Grundriss eines Versuchs' (1851), § 32, speaking of 'the admirable work' of Lobachévski (1840), he says: "This alone is a proof of an extraordinary genius. Probably in the 'gelehrten Schriften' of Kazan University still more is communicated of that wherewith he has made debtor the centuries.

"Here also in the year 1832 appeared at the end of the first (Latin) volume an appendix so very like to that, that to both (since neither had seen the other) must have appeared the same Original of truth after thousands of years."

Then follows a comparison of Lobachévski with Bolyai János, and an elegant characterization of the non-Euclidean geometry.

Fresh after half a century, should not this

strange monument in the history of science find also somewhere speedy reissue?

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

The Psychology of Suggestion. By BORIS SIDIS, M.A., Ph.D., Associate in Psychology at the Pathological Institute of the New York State Hospitals. With an Introduction by PROFESSOR WILLIAM JAMES, of Harvard University. New York, D. Appleton & Co. 1898.

Dr. Sidis divides his book into three parts, entitled, respectively, 'Suggestibility,' 'The Self,' and 'Society.' The interest of the first centers in two series of laboratory experiments and is intended to establish the 'Laws of Normal and Abnormal Suggestibility.' The second aims at establishing in every human being the existence of a 'Subwaking Self,' determining its intrinsic character, its relation to the primary self, its physiological conditions, and its relation to the phenomena of amnesia and insanity. The third ascribes to the activity of the subwaking self, stampedes, social epidemics, and in general the peculiar traits of crowd and mob psychology.

Suggestion is defined as 'the intrusion into the mind of an idea; met with more or less opposition by the person; accepted uncritically at last; and realized unreflectively, almost automatically.'

This definition has obviously been framed with the thought of normal suggestibility in mind, for in states of heightened, or, as Dr. Sidis would term it, abnormal suggestibility, the idea frequently meets with no opposition whatever. Nothing is more common than to see such patients anxiously consider and deliberately realize the suggestions given them. To make it apply throughout, the suggestion should be described as an idea which *would be* met with more or less opposition in the normal state, but which in the normal state is accepted, *usually* uncritically, and realized, *often* unreflectively, while in the abnormal state it meets with little or no opposition.

Yet even as thus amended, the definition would require us to show, before any intruded and realized idea can be termed a suggestion, that it would have met with opposition, of which we have usually no better criterion than such as our knowledge of the tastes and habits of the individual in question can supply.

In Dr. Sidis' series of experiments he endeavored, by very ingenious means, to determine the subject's flow of ideas or to affect his choice of a limited number of alternatives without attracting his attention to the method by which he was influenced. The results are interesting, although one would like to have more precise information as to the conditions under which they were obtained. The main conclusion which Dr. Sidis deduces from these experiments he generalizes into the 'Law of Normal Suggestibility'—'Normal Suggestibility varies as indirect suggestion and inversely as direct suggestion.' Then after a review of the phenomena of hypnosis, he sets over against this 'The Law of Abnormal Suggestibility,' which 'varies as direct suggestion and inversely as indirect suggestion.'

Unfortunately, the distinction between direct and indirect suggestion has nowhere been defined. From the illustrations given, however, we may infer that a suggestion is indirect when it is so administered that it never passes beyond the marginal region. It then remains a mere seed upon the surface of consciousness, never strikes its roots down into the depths below, is merely *apprehended* and not *comprehended.* A normally repugnant intruded idea will then be less likely to arouse opposition and more likely to gain its ends if indirect than if direct, and the first law may be accepted as so far true even without experimental verification. But it should be noted that the numerous cases in which the opposition of the self-consciousness to a direct suggestion is overborne by sheer superior strength of will must be relegated to the class of abnormal suggestions—a more than questionable proceeding.

The second law, however, is by no means true. Increased susceptibility to direct suggestion does not carry with it diminished susceptibility to indirect suggestion. In states of heightened suggestibility, susceptibility to suggestion has no significant relation to the mode in which the suggestion is administered, but rather to the *source whence it comes.* A subject who is acutely sensitive to every suggestion, direct or indirect, that emanates from the person

who has hypnotized him, will be, as a rule, absolutely obtuse to the most direct of suggestions given by any other person. *Rapport*, although not an inevitable, is perhaps one of the most constant traits of heightened suggestibility, and this Dr. Sidis' second law ignores. Furthermore, it puts in an inverse relation traits that usually vary directly.

In his theory of the 'subwaking self,' Dr. Sidis takes ground between Myers and Pierre Janet. With Myers he holds that the subwaking self is a normal constituent of every human being and is not merely a 'disaggregation phenomenon.' With Pierre Janet he denies to it personality and self-consciousness, save in rare cases, and describes it as a congeries of ill coordinated, extremely suggestible, dream-like states. He further concludes that it is possessed of acute senses, but lacks sense and all power of criticism, is servile, cowardly, devoid of morality and of the power of willing. The relation between the primary and secondary selves is not clearly defined. Intercommunication exists, however, to some extent, and the phenomena of hypnosis, suggestibility, automatism, amnesia, insanity and of crowd and mob psychology are ascribed to a dissociation between the two selves whereby the inhibition of the primary is removed and the peculiar traits of the secondary are allowed to come to light.

To frame his physiological theory, Dr. Sidis simply substitutes for his 'moments content,' or psychic element, the nerve-cell, for association, contact of terminal filaments, for dissociation retraction of the terminal filaments and consequent loss of contact. Quite apart from the doubt cast upon 'no-anastomosis-but-approximation-only' theory by the recent publication of Apáthy's work, there never has been any physiological evidence for the theory which Dr. Sidis adopts. It rests solely upon anatomical observations and should not be put forward without due recognition of its speculative character.

But if Dr. Sidis' passion for logical clearness and exact formulation has betrayed him into making generalizations upon insufficient data, it has none the less made his book the more interesting. Even where the daring of his statements challenges dissent, one cannot but feel sympathy for these bold attempts to introduce order into chaos, and for the scientific enthusiasm which inspired them. Attention should also be called to the interesting case of amnesia of which a brief account is given in Chapter XXII. and to the even more interesting series of experiments upon subconscious perception.

WM. ROMAINE NEWBOLD.
UNIVERSITY OF PENNSYLVANIA.

Erkenntnistheoretische Grundzüge der Naturwissenschaften und ihre Beziehungen zum Geistesleben der Gegenwart. P. VOLKMANN. Leipzig, Teubner. Pp. xii+181.

Étude critique du matérialisme et du spiritualisme par la physique expérimentale. RAOUL PICTET. Geneva, Georg & Co. Pp. xix + 596.

Readers of SCIENCE who see also the columns of *Nature* may remember that the former of the above-named books was made not long ago the occasion of a rather sharp polemic by Dr. Karl Pearson on 'the departing glory of German science.' Now it may well be that Dr. Pearson's extended reading justifies his contention of the decadence of science in Germany, but certainly his illustrative examples were hardly well chosen. The *Grundzüge* is not a great book. It may even be one of a class of books not worth writing—an attempt to explain and to justify to a popular audience the scientific movement of the time. The critic justly charges the book with vagueness; with incompleteness; with failure in a labored effort to distinguish between certain scientific terms, as law, rule, principle, hypothesis; and especially with pushing too far loose analogies drawn from natural science and applied to other fields of thought.

But he is particularly severe upon Professor Volkmann for not seeming to have clear vision of the truth that all so-called natural laws are simply laws of the mind. Now the fact is that the book before us is as emphatic as Dr. Pearson himself could be in declaring that scientific laws are always and everywhere, like those of mathematics, constructions of the mind; only the author adds, these constructions *must conform to experience.* See p. 57, etc.

But the criticism is mainly unsatisfactory in

that it does not contain a single allusion to the main purpose or the principal thesis of the book reviewed.

The purpose of the book is to teach liberality of mind. The author summons us to look at every question from many points of view, to learn a wise reserve of judgment and opinion and to grant that there may be much in a subject which we do not know and which may yet be important.

The thesis of the book is that the natural sciences are especially adapted to secure this type of mind. The sciences of nature are not opposed to the sciences of the soul, but should form a whole with them and, through education, penetrate more deeply into the spiritual life of the present time. They are the productive, as the historico-psychological sciences are the reproductive, sciences and form the real motive power of our civilization.

In particular they are adapted to this end by at once stimulating and giving balance to what he terms the *isolating* and the *superposing* habit of mind. What does he mean?

How shall the mind deal with its cerebral baggage, its chaos of sense impressions and experiences? It may consider these mental presentations from a single point of view, rationalize them and build them into a complete and final system, or it may, *in accordance with the interest of the hour*, combine and recombine them and ever hold these constructions open for new material and fresh types.

So the contrasted terms '*Isolation*' and '*Superposition*,' familiar in the principle of the parallelogram of forces, vector analysis and the like, already extended in their application by Boltzmann and others (Wiedemann's *Annalen*, 57, p. 45, 1896), are here made to occupy a central place in the theory of knowledge (pp. 123, 130, etc.).

In education the 'isolating' habit should predominate. Here the great purpose is to form the will, and for this purpose nothing is so well adapted as prolonged attention to some congenial subject from a single point of view. The aim is, through concentration of attention and effort, to secure unity of effect. And this habit of mind will always be useful, especially in art, religion and manners.

But with this ideal of a closed culture, a complete system, a final view of the world and of life, young people would go out into the world children, intolerant, quick in contradiction, unable to see a subject from more than one point of view, judging everything by their narrow system or their personal experience (p. 145).

But education, and particularly scientific education, has another side. It is continually bringing new fields of experience to bear upon and modify the old. Especially in advanced education the man learns to value that which is *essential to the purpose in hand* and to care less about the universal, the complete and the systematic. Every man is continually coming into a new world of interests and activities, and a part of the 'fitness' which secures 'survival' and prosperity is the ability to adjust himself to these changes. A large part of the book, which as a whole consists of detached popular papers and lectures, is made up of examples of these two habits of mind in science and in life.

As would easily be inferred, the author warns us against making too much of the atomistic philosophy. Monism he discredits as being a closed system, a final view. Materialism finds no favor in his eyes for the same reason. 'Science is neither materialistic nor idealistic.'

The second book named above is at once the more interesting and the more important, but a synopsis of it is impossible, as it is itself a synopsis of the whole field of science in the interest of a spiritualistic philosophy. The author, Raoul Pictet, is well known by his early work in the liquefaction of gases. He, too, aims to be useful, especially to educated young men, whom he finds everywhere burdened with doubt, embarrassed by a philosophy of negation, believing nothing, hoping nothing, ready to abdicate personality.

The source of the malady he finds in a prevalent materialism which these young men suppose that science has somehow established. So he writes some 600 vigorous, entertaining pages to show that the materialistic position has not been proved; that, in fact, science disowns it.

The questions: Is man a machine? Is he free? bring us to the physical question: Can all

motion, all change, all intelligence, all feeling, be explained by the impact of matter upon matter or of matter upon ether? This question he pursues relentlessly into the remotest corners of the sciences of nature and man, answering it everywhere with an emphatic No.

But the argument is not wholly negative. The author would prove on the basis of experimental science that there is something in our universe beside matter in motion as the result of impact. Science deals with the question, How; Why and What are matters of taste and intellectual insight? Asking how matter moves, science arrives at the doctrine of the *potential*, gravitational, electric, magnetic, functional, intellectual, etc. The doctrine of the potential is utterly irreconcilable with the materialistic position (pp. 175 to 396).

Of course, much of this matter must be commonplace, as in any systematic exposition, but the recent and the recondite are not neglected, and the author's own researches are freely alluded to and given more fully in the appendices.

The book has a charming vivacity and is full of examples of felicity of statement and diction. It is also rich in anecdote and illustration. Many who would care nothing for the argument of the book would find pleasure in the account of Ampère's experiment (p. 100), of the synthetic free man (p. 355), of the materialistic explanation of whim and fashion (p. 361), of the encounter with a mob (p. 400), and the assassination of Paul I. of Russia (p. 416).

E. A. STRONG.

The Meaning of Education. By DR. NICHOLAS MURRAY BUTLER. The Macmillan Company. Pp. 230. Price, $1.

This book is not a systematic work upon only a single subject; its seven chapters, instead, are mainly addresses that have been delivered in different parts of the country on various themes.

But the subjects chosen are leading questions in modern education; one is the American College and University, two pertain to the secondary school, and the four others involve particularly the aim of education, the characteristics of the new education, the relative values of studies and the relation of evolution to education. The selection of these topics indicates the author's interest in all phases of education, and their treatment reveals his deep sympathy with modern views.

The book is likely to find an especially large number of readers, because it will appeal both to the educational expert and to teachers and citizens in general.

Its value to the specialist in pedagogy is due partly to the real newness of some of its thoughts, partly to their breadth of treatment. For example, few teachers of method have seriously considered the relation of evolution to educational theory; to many, therefore, the first chapter, entitled the 'Meaning of Education,' will open up a new field of thought. Most of these specialists, also, devote their attention mainly to a very few phases of education; such as these Dr. Butler's wide interest and knowledge cannot help but broaden. There is hardly another man in the United States who has had an equal opportunity with him to acquaint himself with the condition of education in this country and abroad. Consequently his statements can rightly be regarded as authoritative. This fact lends great interest to the book, for Dr. Butler is not a man who fails to make concise statements that reveal the exact condition of affairs. For example, on p. 77 he declares, in substance, that most college professors know no more about the science of education than the motorman on a trolley car about the science of electricity—a statement that is certainly interesting and no doubt true.

Partly on account of the above facts, the book will prove of great value to teachers and citizens in general. Dr. Butler is peculiarly a man of the world; he is as well acquainted with the business man as with the teacher, and can make himself as fully understood and appreciated by the former as by the latter. Both will find in this book an outline, in brief, of the new education, but so simply and beautifully presented that, instead of taking offense at it because of its being the 'new education,' they are likely to regard it as entirely sensible. The book will, therefore, do much to establish sympathy among intelligent men and women for modern views on education.

FRANK MCMURRY.

UNIVERSITY OF BUFFALO.

SOCIETIES AND ACADEMIES.

MEETING OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE New York Section of the American Chemical Society held its meeting on the third instant at the College of the City of New York, forty-four members present, and Dr. Wm. McMurtrie presiding.

The following papers were read:

(1) F. J. Pope, 'A Preliminary Note on the Titaniferous Magnetites of Eastern Ontario.'

(2) E. J. Levine, 'A Comparison of Some Methods used for the determination of Starch.'

(3) C. H. Fulton, 'The Assay of Teluride Ores.'

(4) W. S. Meyers, 'Note on a Convenient Method for Maintaining Reduction of Ferrous Solutions.'

(5) C. F. McKenna, 'Slag Cements.'

(6) G. L. Heath, 'A Short Study of Methods for the Estimation of Sulphur in Coal.' Read by title.

Dr. McKenna's paper gave a very interesting résumé of the status of slag cements and was discussed by Messrs. Richardson and McMurtrie.

A report by the Secretary showed that nine regular and two special meetings had been held, at which thirty-five papers had been read, with an average attendance of about fifty. The membership of the section is 276.

The election of officers for the ensuing year took place in accordance with the recent action of the Section in ordering the election for the June meeting instead of October, as formerly, thus enabling the summer months to be more profitably used in accumulating material for the next season's meetings.

Dr. McMurtrie was unanimously re-elected Chairman, after a neat little speech by Professor Bogert, in which the appreciation of the Section was well expressed for the efficient conduct of the meetings during the season. Dr. McMurtrie replied that it was his desire that some one else should succeed him, but that if it were the wish of the section to have him continue in office another year he would not decline, but would continue in the effort to make the New York Section the largest and most active of any of the sections; in which effort, however, he needed and desired the hearty coöperation and assistance of every member, present and absent. On motion the nominations were closed and a unanimous rising vote taken.

Durand Woodman was re-elected Secretary and Treasurer, no other nomination being made, as also the Executive Committee—C. A. Doremus, A. C. Hale and A. A. Breneman. Delegates to the Scientific Alliance—E. E. Smith and Marston T. Bogert.

The next meeting will be held early in October.

DURAND WOODMAN.
Secretary.

TORREY BOTANICAL CLUB, APRIL 12, 1898.

THE scientific program was as follows:

1. Dr. Underwood presented a paper by Rev. E. J. Hill, of Chicago, on '*Vitis Labrusca* and its Westward Distribution,' describing its growth on the sand-hills south of Lake Michigan, there showing, among its specific characters, a tough skin and pulp, large seeds, blue to vinous-purple color, and globose or depressed fruit even larger than in cultivated varieties, such as the Concord.

Discussion followed, Dr. Britton speaking of the high value to be attached to the character founded on intermittent tendrils. The Secretary and Dr. Rusby spoke of pink, purple and other colors among its variants in nature. Mr. Rydberg mentioned the similar wide range of color-variants in *Prunus* in Nebraska, where leaf and other characters may be indistinguishable, but the fruit will vary in color, and also in flesh, taste and flavor.

2. A communication on 'South American Piperaceæ' was presented by Dr. Rusby, on behalf of Professor Casimir de Candolle. Professor de Candolle, in studying the last of the collections in this family made by Mr. Bang, had also determined a considerable number of Bolivian specimens pertaining to the early collections of Weddell, Mandon and others. Among the results were the eleven new species now described. These new species were exhibited, and remarks were also made by Dr. Rusby descriptive of the habits and appearances of these plants as they grow in the Andes.

Dr. Britton spoke of the interest attaching to the Piperaceæ as the simplest type of the Dicotyledons, because of the simple character of the

carpels, fruit and tissues. Dr. Rusby referred to the separation of *Saururus* from the Piperaceæ, and to Dr. Henry's investigations now in progress upon a *Saururus* in China.

3. The next feature of the evening was the exhibition, by Dr. Britton, of a large and interesting set of blue prints from tracings made from Mexican plants. The originals were sent by Mocino and Sesse to M. Alphonse de Candolle at Geneva, but these and the accompanying text remained unpublished. Recently the text has been issued by the Mexican Natural History Society. The elder de Candolle furnished a series of tracings to Dr. Gray, from which the blue prints exhibited have been made at the instance of Dr. J. N. Rose, of Washington, D. C. An index and preface to the blueprints has been supplied by M. Casimir de Candolle.

4. The subject next following was that of those members of the Convolvulaceæ which form large fleshy roots, introduced by Dr. Rusby, who exhibited specimens of the roots of *Ipomœa pandurata* sent by Mr. C. R. Beadle, of Biltmore, N. C. Three fusiform roots reached from 3 to 4½ feet long, 3 to 5 inches thick, and also developed at least one foot of slender root above, below the surface of the ground. One of these was forked, suggesting its name of 'Man in-the-Ground.' Medicinally it is used as a purgative.

Dr. Rydberg referred to the thicker, shorter root of *Ipomœa leptophylla*, which has a sweet taste, and frequents hillsides, where its roots serve as a storehouse for moisture as well as for starch.

Dr. Rusby suggested that the resinous matter found in these roots may be primarily a waste product, but is perhaps useful to the plant as a means of preventing its being eaten by enemies.

5. The next communication was from Mrs. E. G. Britton, on 'A Hybrid Moss.' Mrs. Britton exhibited Contribution No. 72 from the Herbarium of Columbia reprinted from the *Bulletin* for February, 1895, showing plate 231 to illustrate a hybrid of *Aphanorhegma serratum* collected by Drummond near St. Louis, Missouri, in 1841, and stated that the same hybrid had been rediscovered by Mr. D. A. Burnett on December 12, 1896, near Bradford, Pennsylvania, along the Erie Railroad, on a heap of ashes left by burning old ties, and that it was associated with *Bryum argenteum* and *Funaria hygrometrica*. As in the case of Drummond's specimens, the antheridial parent is unknown, but was probably *Physcomitrium turbinatum;* it scarcely seems possible that it could have been *Funaria*. The specimens agree in every way and show various degrees of heredity from each parent. On most of the plants typical immersed capsules of *Aphanorhegma* occur together with either one exserted, long-pedicelled capsule of *Physcomitrium* or with two smaller immersed capsules more closely related to *Physcomitrium* than to *Aphanorhegma*. As in Drummond's specimens, the apical lid with a clearly differentiated border, the shallow spore-sac, and especially the different cell-structure of the walls and the less developed spores, clearly distinguish the hybrid sporophytes from typical *Aphanorhegma*.

Discussion followed regarding hybrid ferns and respecting *Asplenium ebeneum* and *A. ebenoides*. In answer to questions by Dr. Rusby, Dr. Underwood said that where both species grow together in North Carolina he finds *A. ebenoides* growing beneath cliffs, but *A. ebeneum* in different situations about the edges of bowlders, while the associated fern *Camptosorus* inhabits only the flat tops of the rocks.

EDWARD S. BURGESS,
Secretary.

NEW BOOKS.

The Study of Man. ALFRED C. HADDON. New York, G. P. Putnam's Sons; London, Bliss, Sands & Co. 1898. Pp. xxv + 410. $2.00.

Syllabus on Vertebrata. EDWARD D. COPE. With an introduction by HENRY F. OSBORN. Philadelphia, Published for the University of Pennsylvania. 1898. Pp. xxxv + 135.

Hand-Book of Nature Study. D. LANGE. New York and London, The Macmillan Company. 1898. Pp. xv + 329. $1.00.

Nature Study in Elementary Schools. Reader: Myths, Stories, Poems. MRS. LUCY LANGDON WILLIAMS WILSON. New York and London, The Macmillan Company. 1898. Pp. 181. 35 cents.

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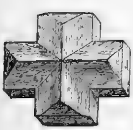

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